NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

No. 17. Vol III. JULY, 1893.

NOTES AND COMMENTS.

The Museums Association.

THE season for annual congresses has arrived, and in Britain the Museums Association meets first among scientific bodies. This year, as we have already announced, the meeting is to be held in London, under the presidency of Sir William Flower, K.C.B., who delivers the opening address on July 3. The Association has already done much towards discussing the methods of Museum arrangement, and agreeing upon concerted action in various matters; but a meeting in the metropolis, where Museums, backed by the resources of the Government, have attained their greatest development, ought to lead to particularly important results.

Truly enough, there is much to be done in reforming many of the provincial Museums, if their efficiency is to be maintained and extended in accordance with modern ideas. Last year we had occasion to remark upon the peculiarities of some of the older foundations;[1] and, notwithstanding all the efforts of the Museums Association, we fear it will be long ere the collections "illustrating the travels of the local gentry" give place to the adequate representation of the Natural History of the neighbourhood in which each Museum is situated. Even newly-founded institutions, such as that at the Brassey Institute, Hastings, which begin well and with good intentions, soon find the difficulty of refusing to accept "curios" from local travellers; and until the governing bodies of the Museums are composed exclusively of scientific men who understand such matters, it is hopeless to expect any noteworthy reform.

We cannot help thinking, however, that the greatest difficulty in attempting reform results from the ignorance of most of the governing bodies of the Museums as to what constitute the qualifica-

[1] Natural Science, vol. i., p. 321.

tions and duties of a Curator. If the Museums Association could make its voice heard on this subject in the Town Councils of the land, it would be doing good service. Very frequently a Librarian is supposed to supervise the Museum; he may have an assistant for the actual work, but even if that assistant be an expert, he is allowed no independent judgment. Only within the last year, the Committee of one great public Museum in Britain refused to take the advice of an expert and appoint a trained Curator, preferring the claims of a respectable tradesman, who happened to have local influence, and who may or may not prove a success in his new duties. The climax was reached in our experience, however, a few months ago, when the following advertisement appeared in a contemporary—not in an ordinary newspaper, but in a journal that comes regularly under the notice of scientific men:—

> WANTED.—A resident Curator, Meteorological Observer, and Caretaker for the Museum and Library Buildings of the Royal Institution of Cornwall, Truro. Salary, £50 per annum, with rooms, coals, and gas. Applications in Candidate's own handwriting, stating Age and Scientific Qualifications, with Testimonials and References, to be forwarded, not later than February 14, to Major Parkyn, Truro.

We have no information as to the result of this munificent offer to a trained naturalist, but if anyone could be found at the price, it would be of great interest to the Museums Association to learn from Major Parkyn the nature of the "scientific qualifications" he obtained so cheaply. Even if the salary were adequate, it would be difficult to find any one man competent to undertake so many duties; and if the funds of the Royal Institution of Cornwall are so low that it cannot afford more than its present expenditure, it might at least be satisfied with a caretaker to keep things free from dust and mildew until better days.

Curators who know anything of their work cannot be had for less pay than a gardener or coachman, whatever the people of Truro and similar towns may think; and when the Museums Association has duly established that fact, it might profitably direct attention next to the question of "honorary curators." In theory it is, no doubt, an excellent idea to have a committee of specialists to assist the curator in the scientific details of the various departments over which his work ranges; and in many instances it is not possible otherwise to ensure accuracy in the labelling of the specimens. In practice, however, so far as our experience goes, the honorary curator is usually an ornamental personage who never looks at the cases from any other point of view than that of a draper arranging his shop window. We know a certain "honorary curator of the department of conchology" in one of our largest provincial museums, who had not even heard of Woodward's "Manual" until long after he had entered upon office. When such nonentities are appointed, they

simply meddle in general questions of administration and arrangement, which ought to be solely under the control of a competent curator; and the sooner the system now in vogue is abolished, the better will it be for the development of the museums.

We heartily wish success to the Museums Association in its efforts to benefit the community in these and other directions; and under the brilliant patronage with which the London meeting is favoured, much progress ought to result from the proceedings of this year.

The Antarctic Whaling Expedition.

As many of our readers are doubtless aware, a whaling expedition comprising four ships—the "Balæna," the "Diana," the "Active," and the "Polar Star" left Dundee in September last to try their fortune among the whales and seals of the Antarctic Ocean. Their destination was the region visited by Ross in his third Antarctic voyage in the years 1842–43; and the prime object of search the southern Right Whale (*Balæna australis*). Seeing how rarely the Antarctic regions are visited, and how imperfect is still our knowledge of their geography and natural history, it was arranged that the medical and some of the other officers of the expedition should endeavour to make observations, and collect specimens, so far as the exigencies of their other duties permitted.

The expedition has now returned safe and sound, and one of its members has contributed a preliminary account of its doings to the *Times*, from which we take the following summary.

It appears, indeed, that while much important information has been acquired as to the meteorology of the Antarctic, and some additions made to geographical science, the general scientific results are not so satisfactory as was hoped would have been the case; this being mainly due to the time of all persons on board being fully occupied in capturing and flensing seals, during the period when the vessels were in the most interesting regions. During a short stay in the Falklands, the officers learnt that the Antarctic fox is becoming well-nigh extinct; while Darwin's prophecy that the wild horses and cattle would eventually be replaced by the more remunerative sheep is being rapidly fulfilled. Moreover, through incessant pursuit, the fur-seal, although still found, is comparatively rare.

The first iceberg was sighted in lat. 59° 18′, and the same day (December 16) Cape petrels, and other members of the same order, were met with in shoals, while the seas were found to be absolutely swarming with various species of finner whales. Soon after the first seal was descried and promptly despatched; the species is not identified, although it is stated to be one of those first discovered by Ross. On the 22nd, flocks of sheathbills were met with, while, on the next day, the presence of the lovely white petrel and the olive colour of the water indicated the proximity of the pack-ice.

Although no right whales were sighted, a large number of seals, of various kinds, were taken, and by the middle of February the vessel in which the *Times'* correspondent sailed had secured its full quota. Three different kinds of seals were taken, which are described as the "large seal," the "white Antarctic seal," and the leopard seal. The species of the last is, of course, certain, while the second would appear to be the crab-eating *Lobodon carcinophaga*, and the first is probably Widdel's sea. (*Leptonychotes weddeli*). Besides these, it is stated that the party came across a fourth kind of seal, described as of large size, with a small head, small flippers, thick blubber, and a rather woolly pellage. Possibly this may prove to be the rare *Ommatophoca rossi*, at present known only by two immature examples; but, in any case, it is to be hoped that skulls and skins of all these seals have been brought home in a state fit for scientific examination. The writer describes the Antarctic seals as very foolish creatures. "The present generation have never seen man, and they survey him open-mouthed and fearful, during which process they are laid low with club or bullet. Sometimes they are so lazy with sleep that a man may dig them in the ribs with the muzzle of his gun, and, wondering what is disturbing their slumbers, they raise their head, which quickly falls pierced with a bullet. There may only be one seal on a piece of ice, which is usually the case with the larger kind; but the smaller kinds lie in half-dozens and tens, and as many as 47 were seen on one piece. Seldom do any escape—one cartridge means one seal."

PROTOPLASM.

AT a recent meeting of that very up-to-date society, the Oxford University Junior Scientific Club, Professor Ray Lankester exhibited a fine specimen of a creeping plasmodium. On the general subject of protoplasm he said that a very common error at present was to abuse the word protoplasm. It is *not* the name of any chemical substance, but of the living slimy material which is to be seen round the nucleus constituting the substance of all living cells. To this substance the name was first given some forty years ago, and for this substance the name must be retained. It was quite true that probably a definite chemical substance of very high complexity was present in all protoplasm—a substance to which the name "Proteil" might be applied if that name had not been appropriated for the hypothetical basal form of all matter. This chemical substance might never be isolated and worked out. By its very nature it was extremely unstable—changing its composition, vanishing, dissolving almost as you looked at it—and in living protoplasm besides this substance there must be present always a number of chemical substances, some of them on the way up to the highest point, some on the downward path. The late Professor Moseley always insisted on a similar

view. He used to say that the protoplasm probably of every different kind of cell, and certainly of every different plant and animal, was different. There were a great many protoplasms, for protoplasm was simply the name of a physical appearance always found in living cells, and in actual chemical composition varying from cell to cell, from organism to organism, and from moment to moment; but underlying all this flux of living material, no doubt, there was one definite chemical compound identical in all living matter.

Recent Work on the Foraminifera.

The chief activity in the study of Foraminifera has of late years been removed to Italy, and we are indebted to Fornasini, Tellini, Dervieux, Malagoli, and Mariani for a great number of papers, chiefly on the Tertiary forms, of more or less importance. The last one to hand is by Dervieux, who writes upon the Tertiary *Frondicularia*e of Piedmont (*Bull. Soc. Geol. Ital.*, vol. xi. (2)). There are eleven forms figured, most of which are well-known, and some of which are common both to the Chalk and Tertiary deposits elsewhere. Three are named as new, but surely fig. 17 is *F. medelingensis* of Karrer.

Schlumberger, of Paris, has contributed to the *Mémoires* of the Zoological Society of France (vol. vi.) another of those elaborate researches into the Miliolidæ—*Monographie des Miliolidées du Golfe de Marseille*. The material was supplied to him by M. Marion, and was obtained from the "zone à Bryozoaires," in the gulf of Marseilles, at a depth of 30–40 metres.

Schlumberger picked out the Miliolines, numbering about 20, and has described and figured them with his customary exquisite care. No *Biloculinæ* were found, but there were 3 *Spiroloculinæ*, one receiving a new name (*inæquilateralis*); 1 *Sigmoilina* (*costata*, n. sp.); 4 *Triloculinæ* (*marioni*, n. sp.); 10 *Quinqueloculinæ* (*stelligera*, n. sp.); 2 *Massilinæ* (a new genus "of which the early chambers are arranged in five symmetrical planes, as in *Quinqueloculina*, while the last are placed in two planes or a single common plane of symmetry passing through the axis of the poles as in *Spiroloculina*") the species being *secans* (*Quinqueloculina*, d'Orbigny, no. 43 Tableau Méthodique) and *annectens*, n. sp.; and 3 *Adelosinæ*. The illustrations are given in four plates, photographed from drawings by the author, and the paper is further illlustrated by thirty-seven of those beautiful sections that M. Schlumberger has delighted us with so often. We regret to see our old friend *Q. secans* disappear, but we have long since recognised the jeopardy of all *Miliolinæ*, which now cannot be safely named without the precaution of making sections and studying the internal arrangement of the test.

The most interesting event to be chronicled is the return of the prodigal son, M. E. Van den Broeck, who has fed for long off Japanese husks and now returns to his foraminifera. Van den Broeck has

published an "Etude préliminaire "(*Bull. Soc. roy. Malac. Belgique*, vol. xxviii.), and an "Etude sur le Dimorphisme des Foraminifères et des Nummulites en particulier" (*Bull. Soc. Belge Geol.*, vol. vii.). The latter is an elaborate paper of 41 pages, and discusses at length the views of Hantken, De la Harpe, Munier-Chalmas and Schlumberger, Tournouer, Fischer, and others, and states the following conclusions:—*A*. That dimorphism in the Foraminifera is met with in all types where conditions of life are favourable to existence. *B*. Dimorphism is "of absolutely initial origin and in relation with the origin of life itself." *C*. The characteristic of dimorphism in the Foraminifera is, as a general rule, furnished by the contrast existing between the dimensions of a section of the adult of two forms of the same species, and the dimensions *in an inverse sense*, and infinitely more accentuated, of the section of the central or initial chamber. *D*. From the similarity of external characters, etc., it is easy to assure oneself that the two forms *A*. and *B*. not only belong to the same group or zoological subdivision of one genus, but even to the same species. *E*. As to the difference in shape of the two forms in the adult state, the character of the spire, form and number of chambers, they never present but secondary variations. *F*. The difference of the initial stage appears due to the fact that *the Foraminifera reproduce themselves by two distinct processes* (*fission* and *gemmation*) [previously pointed out by Fischer (1870) and Dollfus (1890); see M. Van den Broeck's paper, p. 15]. *G*. Gemmation is well-known among the Foraminifera, Fission among the Freshwater Rhizopoda. The shells of Foraminifera may be a true colony, of which the individual of each successive chamber may, by a kind of fission, be the product of the division of the preceding, remaining attached to the colonial skeleton by a non-liberated test. *H*. Whether the differential characters noticed in the dimorphous tests are connected with the shape and disposition of the chambers or the external characters, or whether these characters are connected with the spire, form, number, or grouping of the chambers in the forms *A*. and *B*. of the same species, or even the respective abundance of *A*. and *B*. in the same habitat, we ought to state, in favour of the principle of initial dimorphism, that these differential characters find, without trouble or argument, their *raison d'être* precisely *in the natural consequences of initial dimorphism*, due to the contrast in the reproductive processes. *I*. The sole objection that may be opposed to this interpretation, consists in the fact that to justify two initial forms in the same species it is necessary to prove—which does not yet appear to have been fully done —the existence of embryonic stages or at least young individuals showing, as in *A*. and *B*., large and adult forms, the divergence into megasphere and microsphere of the initial chambers. *J*. One may be able reasonably to add to the phenomenon of expulsion, setting aside the last external chambers of Nummulites, the fact that never has anyone noticed or figured an adult Nummulite, entire and intact, showing a mouth or opening perfectly preserved. *K*. Looking at the

question of the duality of the process of the Foraminifera, as much as at that of the support afforded to the Theory of Fission by the method of individual examination of the contents of each Foraminiferal chamber, the importance which must be attributed to the *question of nucleus among the Foraminifera* demands a complementary system of observation. For further detail and argument, the student must be referred to Van den Broeck's paper, as we have already exceeded the space at disposal; but the communication is so interesting and important that it appears an obvious advantage to quote at this length.

The Distribution of Seeds.

We are glad to observe the tendency of biologists at Cambridge to wander more and more from the long-prevalent exclusive fashion of section-cutting, and to attempt to solve some of the wider problems in the science. Another interesting item of research in this direction was communicated to a recent meeting of the Cambridge Philosophical Society, when Messrs. J. C. Willis and J. H. Burkill recorded their observations on the flora of the pollard willows near the University town.

The plants occurring in the tops of the willows near Cambridge have been recorded during the last few years, and amount to 80 species, occurring 3,951 times altogether in about 4,500 trees. Of these 80, only 18 form more than 1 per cent. of the total number of records. The rest have only a small number of records. As Loew has pointed out in a recent paper, these plants are of interest from the points of view of distribution of seeds and of epiphytism. Classifying them according to means of distribution, we find that 19 species have fleshy fruits; 1,763 records (44·6 per cent.) of these occur. Three species with burrs have 651 records (16·4 per cent.); 34 species with winged or feathered fruit or seed have 996 records (25·1 per cent.); 7, with very light seeds, have 421 (10·6 per cent.); and finally, of plants whose means of distribution is poor or somewhat doubtful, we have 17 species with 120 records (2·9 per cent.). It is thus shown very strikingly how the various distribution-mechanisms succeed, only the better ones showing in the list in any numbers. The bird-distributed plants figure much higher here than in such cases as, for instance, the flora of the churches of Poitiers (Richard).

The observations show clearly the fact that a seed is only carried a short distance by its distribution mechanism. Plants were always found upon the soil, within 250 yards at most, of those found in the trees. An analysis was made as far as possible of the birds' nests found in the trees, and pieces, often with ripe fruits, of many plants in the list were discovered in them, so that probably this means of distribution is of some importance.

With regard to epiphytism, Loew considers these plants as beginning this mode of life. Like true epiphytes, they possess good

methods of seed distribution. Their position does not call for any special means of supporting themselves, and the supply of humus is plentiful. *Mycorhiza*, which Loew found on many, was not observed in the few examined. The size of many of the shrubs, *e.g.*, Elder, *Ribes*, Rose, etc., was very remarkable; some elders were 3 inches thick or more, and as much as 12 feet high. Experiments are in progress upon the growth of plants in willow humus.

EXPEDITIOUS SCIENTIFIC RESEARCH.

REFERRING to Biology at Cambridge, we cannot refrain from recording that at the meeting of the Zoological Society of London on June 6, the exhibition of an egg of *Ornithorhynchus* was made the occasion for some indignant remarks on the action of a member of the University, in suppressing and rendering useless for the purposes of science, materials collected at the public expense in the haunts of *Ornithorhynchus* and *Ceratodus* in Australia. If Mr. W. H. Caldwell is unable to make use of the specimens he was deputed to collect, it is high time that he reported to that effect to the public institutions that endowed his research; and it would be well if in future the Royal Society added some clause to the conditions on which the Government grant is awarded, preventing any repetition of such circumstances. As biologists, we are glad to learn that one of the German Universities has undertaken the work of supplying us with information concerning the early stages in the life-history of the duck-bills and *Ceratodus*, and will shortly publish the preliminary results; as Britons, we cannot but regret that it should be necessary to depend upon the resources of a foreign nation for the solution of some of the most important problems in the Natural History of one of our own colonies.

WILD-FLOWERS AND DROUGHT.

IN the *Journal of Botany* for June, Mr. C. B. Clarke gives a few notes on the effect of the warm, dry spring on our wild plants. "A great number of annuals," says the writer, "usually regarded as autumn annuals, have already run their course." On May 6 a quantity of *Valerianella olitoria* was collected, not only in ripe fruit, but with the whole plant whitened as seen in corn-fields after harvest. The fruits contained abundance of perfect seeds ripe. On the same day various banks in Surrey were seen to be golden-yellow with the Mouse-ear Hawkweed (*Hieracium pilosella*). Two other Hawkweeds, (*H. murorum* and *H. sylvaticum*) were gathered in flower, the latter also "off flower" within the next eight days; their normal flowering season, according to the "Students' Flora," is July–September. The Heath *Erica tetralix* was almost as precocious, for a large bundle was picked in full flower at Bournemouth on May 18. Examples in full flower of nearly all the common autumnal weeds

were collected, such as *Centaurea scabiosa*, *Erythræa centaurea*, *Jasione montana* and others.

One effect of the drought was the shortening of the stems of many plants, thus the Marsh Thistles were flowering plentifully with stems less than one inch long. A small Pond-weed (*Potamogeton polygonifolius*) had flowered abundantly with stems one to two inches long on nearly dry mud, while the same species, abundant also in the streams, showed no signs of flowering; the warmth of the water causing, on the other hand, a luxuriant growth of stem and leaves. This was also generally found to be the case with water-plants, which have not flowered much earlier than in some other seasons. It is noticeable that in no case was there indication of blossom on the Sundews or *Hypericum elodes*, though all three plants were observed in every state of moisture from saturation to desiccation.

Dr. Forsyth Major on Squirrels.

In criticising a certain book in a previous number of this Journal, we had reason to call attention to the circumstance that, in our opinion, the author had selected too comprehensive a title. We have now to mention a case where an author has done himself injustice by choosing a heading to his paper which errs in the opposite direction. We refer to a paper just published in the *Proceedings of the Zoological Society* (1893, pp. 179–215) by the well-known palæontologist, Dr. Forsyth Major, under the designation "On some Miocene Squirrels, with Remarks on the Dentition and Classification of the Sciurinæ." Any person reading the title would, we submit, imagine that the fossil squirrels were the important part of the paper; whereas, as a matter of fact, they form but an insignificant portion of its contents. The paper is, indeed, not only a re-classification of the squirrels, but also comprises a most important discussion on the question of tritubercularism and the origin of the various types of mammalian dentition; the title giving not the slightest inkling of the latter portion of its contents. Although, at present, we have been able to give it only a hurried perusal, while we are by no means sure that we agree with many of its conclusions, the paper appears to us one of the most important that have been published for some years.

In regard to classification, Dr. Major, following the suggestions of some previous writers, utterly scouts the division of the squirrel-family into the Sciurinæ (true squirrels and flying squirrels) and Arctomyinæ (susliks and marmots); and divides it into the Sciurinæ Pteromyinæ, and Nannosciurinæ. The former embraces the grooved-toothed squirrels (*Rhithrosciurus*), the spiny squirrels (*Xerus*), the true squirrels (*Sciurus*)—the latter genus including the chipmunks (*Tamias*)—and the susliks and marmots. The second sub-family is represented by the three genera of flying squirrels; while the third includes the pigmy squirrels (*Nannosciurus*), which have been generally

placed in *Sciurus*, from which they are distinguished by their dormouse-like dentition. It will thus be seen how radical are the changes in classification.

Fossil teeth indicate that flying squirrels were abundant in the Miocene; and their occurrence there, with other circumstances, leads the author to conclude that they have originated quite separately from the Sciurinæ, even if they belong to the same family.

To enter into a discussion of the author's opposition to trituberculism would greatly exceed our limits; but we may mention that he believes that the Eutherian dentition has been derived from a direct modification of the multituberculate type, and that trituberculism is a secondary feature due to reduction. Certainly, one of the figures of a squirrel's molar reminds us very strongly of a molar of the duck-bill, and, as far as it goes, is suggestive of the derivation of both from a type in which the cusps were arranged in parallel longitudinal series. To believe, however, that "*Microlestes* may prove to be a remote ancestor of the Eutheria," if it had incisor teeth at all like those of its ally *Plagiaulax*, is, however, very difficult. We shall await with interest what the Transatlantic palæontologists have to say on the subject.

The Bison in the Caucasus.

Hitherto there has been much uncertainty as to the localities where the bison still remains in a wild state in the Caucasus, and naturalists are accordingly much indebted to Dr. Radde for clearing up this point in a brief communication published in the *Proceedings of the Zoological Society* (1893, pp. 175–7). The Doctor tells us that the animal is confined to the district around the sources of the Laba and Bjellaja on the north side of the range, extending eastwards from the former locality to the springs of the Selentschûk. It is, however, everywhere scarce, being generally met with only in twos and threes, although occasionally as many as five have been seen together, and once the tracks of a party of seven were detected. The survivors appear to have lost their original settled habits, and to have become wanderers in their last refuge, having, in some cases, crossed the main ridge of the Caucasus and made their appearance on its southern flanks. As there is, unfortunately, but too much reason to fear that the Caucasian bison will, ere long, have ceased to exist, we are glad to hear that Dr. Radde hopes to be able to publish an exhaustive memoir on the anatomy, distribution, and habits of this animal.

A Restoration of Ichthyosaurus.

Some months ago Mr. Lydekker referred in these pages (vol. i., p. 514) to Dr. E. Fraas' discovery of a specimen of the extinct marine reptile, *Ichthyosaurus*, showing the form and proportions of the dorsal and caudal fins. In the second edition of the Rev. H. N. Hutchinson's "Extinct Monsters," to the issue of which we referred

RESTORATION OF ICHTHYOSAURIAN REPTILES. By J. SMIT.
(*From* H. N. Hutchinson's "Extinct Monsters," second edition.)

last month, Mr. Smit has attempted a new restoration of the animal based upon this discovery; and by the courtesy of the author and publishers (Messrs. Chapman and Hall) we are able to reproduce the sketch on the previous page. The curious downward bend of the vertebral column into the lower lobe of the caudal fin is well indicated; and a life-like drawing of this kind affords a much more vivid conception of the animal than the original outline sketch of Dr. Fraas. We may add that Mr. Smit has executed other new restorations for Mr. Hutchinson's second edition, and criticisms of the first issue have been turned to profitable account.

CAVERN EXPLORATIONS.

LITTLE has been done of late in the exploration of caverns—perhaps there remains now little to be learned concerning the ancient fauna of which they provide evidence. Dr. Eberhard Fraas, however, has been examining the Irpfel cave in the valley of the Brenz, Würtemberg (*Zeitschr. deutsch. geol. Gesell.*, 1893), and Mr. E. Harlé has published, in the *Comptes Rendus* of the Natural History Society of Toulouse, an elaborate summary of the distribution of the Quaternary mammals in the south-west of France.

The cavern in Würtemberg investigated by Dr. Fraas proves to have been a hyæna-den, with some evidence of occupation also by the cave bear and man. The animals found distinctly indicate a Steppe-, not a Forest-fauna; and it is quite evident that the reindeer was contemporaneous with the mammoth, rhinoceros, and hyæna. It is also definitely proved, from the occurrence of flint-flakes, that man lived with these animals in Southern Germany.

The researches of Mr. Harlé also show that the country to the north of the Garonne was a great steppe—not a forest—at the same period. Remains of the Saiga antelope and *Spermophilus* are widely spread, and in four instances they have been found associated. The steppe is believed to have been replaced by forests at the end of what is termed the "Magdalenian" period, when there is reason to suppose that the climate became warmer and more humid.

OUR MONTHLY SELECTIONS.

THE office boy, or his equivalent so far as scientific matters are concerned, is more conspicuous than ever in the newspapers this month. We must, however, content ourselves with three selections from the Natural History provided for the edification of the general public.

Last month the *Westminster Gazette* tried to discourse learnedly on botanical questions, and provided some amusement for the readers of the June *Journal of Botany;* but this month it has even excelled itself by an attempt at a popular exposition of the Insect House in

the London Zoological Gardens. The fact that the journalist failed to count the legs of the stick-insect correctly may be excusable, if he were only a casual visitor; but he might at least have mastered some of the rudiments of zoology before he recorded his observations on the Atlas moth. This, we are told, "is rather bird than insect, and the wings have a depth and softness of plumage which seem to bring it within the animal kingdom." If moths are not animals, and if birds are animals that have evolved from insects, it is a misfortune the *Westminster Gazette* does not expound to us its new philosophy.

For further strange notions of zoology we may turn to the *World* of May 31, where we read:—"I have entitled this story 'Ponsonby and the Pantheress,' because Ponsonby's nocturnal visitor undoubtedly belonged to the genus Carnaria, species *F. pardus*, the *Pardalis* of the ancients." The confusion between *order* and *genus* is delightful, while the meaning of the mystical "*F.*" is apparently left to the intelligent reader.

Finally, in a notice of the skeletons of a man and horse recently mounted side by side in the Natural History Museum, published in the *Graphic* of June 10, we obtain the following information:—"In the *carpus* (wrist-bones) of the horse a further reduction in the number of bones as compared with man takes place, but it is especially in the bones which constitute the hand in man (*metacarpus*) in which extraordinary modifications will be noticed. It will be apparent that what is popularly known as the knee in the horse's foreleg is not the knee, but the middle finger in the human hand, greatly developed and strengthened to sustain the enormous weight of the horse's fore-quarters. It has the same number of parts as the human middle finger, and is terminated by the hoof, which corresponds to the nail of that finger." The uninstructed public are likely to be greatly benefited by the information that the terms metacarpus and hand are synonymous; while when they read that the horse's knee is the equivalent of the human third finger, even their proverbial faith in the so-called popular scientist is likely to receive a rude shock.

THE *Daily Chronicle* of June 10 quotes some curious observations recorded by Dr. Hovey on the effect of the pure air of the Mammoth Cave of Kentucky on the senses of smell and hearing. After coming out of the cave, the odours of the outside world, of the trees, grass, and flowers, are so strangely intensified that the different trees can be distinguished by scents inappreciable after breathing the ordinary air for half-an-hour. This effect is, to many sensitive natures, so over-powering that some of the visitors suffer from headache and nausea by a too sudden change from the densely oxygenated atmosphere of the cavern to the more impure one outside it. Hearing is also stimulated. All of the cave animals—which are blind—are so keenly endowed with this sense, that they dart away with rapidity should even a grain of sand fall on the surface of the water. Yet, if perfect silence

is preserved, so unconscious are they of the presence of an enemy that they can easily be captured by the hand or net when swimming about.

EARLY in the century lions were comparatively abundant in India, but at present they appear to be exclusively confined to the Gir of Kathiawar, where they are preserved by the Government. Two fine specimens are reported to have been recently shot by the Governor of Bombay and a party of sportsmen.

WE have received from Professor Duns a copy of the abstract of his paper on the early history of some Scottish mammals and birds, appearing in the *Proc. Roy. Soc. Edinburgh*, session 1892–93. It is a plea for the more "adequate description of the environment, physical and vital, of the mammals and birds earliest recorded by Scottish observers." The author enumerates the old publications to which reference may be made.

IN reference to the drought, the *Gardeners' Chronicle* of June 10 gives statistics showing the unusually early ripening of the first Pea crops. The record (supplied by Messrs. Hurst & Son) extends over ten years, and is as follows:—1883, June 21; 1884, June 26; 1885, June 24; 1886, June 24; 1887, June 25; 1888, June 26; 1889, June 16; 1890, not given, probably about June 18; 1891, June 27; 1892, June 15; 1893, June 4–6 at the latest.

IN the previous week's issue of the same journal the statement is reported that, owing to the drying up of ponds and watercourses, thrushes in the southern counties, especially the dry county of Hampshire, have been forced to build their nests without the usual mud lining. The question is put: How many droughty years would be needed to destroy the habit entirely?

IN reference to Mr. Clarence King's recent ingenious estimate of the age of the Earth (NATURAL SCIENCE, vol. ii., p. 81), the Rev. Osmond Fisher contributes an interesting article to the current number of the *American Journal of Science* (ser. 3, vol. xlv., pp. 464–468), pointing out that the rigidity of the Earth cannot be relied upon in estimating its age. He considers the supposed fact that the globe is rigid, still remains to be proved; hence no argument can be founded on it.

THE so-called primæval fossil, *Eozoon canadense*, has been subjected to so much destructive criticism that there are now few believers in its organic nature; but until this month no analogous structure had

been recorded as found under conditions that could explain the origin of so curious an arrangement of different minerals. At the meeting of the Geological Society of London on June 7, however, Dr. Johnston Lavis exhibited some ejected blocks of metamorphosed limestone from Monte Somma displaying a perfect eozoonal structure. They have been studied most carefully by Dr. J. W. Gregory and himself, and their microscopical characters correspond in all details with those of the original Canadian specimens. In many cases, on account of their freshness, the Monte Somma blocks exhibit some of the pseudo-organic structural details, such as the stolon-tubes, in far greater perfection than does the true so-called *Eozoon canadense*.

In the *Transactions of the Connecticut Academy* (vol. ix., March, 1893), Dr. C. E. Beecher has a paper on the "Revision of the Families of the Loop-bearing Brachiopoda." He arrives at the conclusion that the Terebratellidæ certainly appeared before Jurassic times, because they were well represented by several characteristic genera (*Kingena*, *Ismenia*, *Zellania*, and *Megathyris*); that among recent species, several separate generic and specific names may have been given to stages of growth of a few species; and that species must be based upon surface ornaments, colour, and form, with certain limits, and genera only upon structural features developed through a definite series of changes, the results of which are permanent in individuals evidently fully adult.

A second paper by the same author follows, on "The Development of *Terebratalia obsoleta*, Dall." This is illustrated by three plates, of which the first shows the development of the brachial supports in the Terebratellidæ, dealing chiefly with the *Megathyrinæ*, the *Dallininæ* and the *Magellaniinæ*; while the second and third plates are almost entirely concerned with the same structure in *Terebratalia obsoleta*. Like so much of Dr. Beecher's work, this is thoroughly worked out, and presents points of interest as well to the general reader as to the specialist.

In the *Zeitschr. für romanische Philologie* for April there is an interesting paper on the Italian popular names of the Bats, by Dr. C. J. Forsyth Major. Dr. Major is, fortunately, both a naturalist and a philologist, and one can therefore depend upon his determinations and researches. Not only from Italy itself has the author busied himself in rescuing these interesting words, but also from Corsica, Vaud, Savoy, the Jura, the Vosges, Dauphiné, Provence, etc., etc. Among the words in use that Dr. Major traces to the Latin *Vespertilio*, are:—Tuscany, *vipistrello*, *vispistrello*, *pipistrello*; Florence, *pripistrello*; Figline, *pimpistrello*; Prov. Massa, *spertello*; Prov. Macerata, *spiridillo*; Tenerano, *papastrello*; Premilcuore, *baibastrel*; Imola, *balbastré*; Padora, *barbastrégio*; Venice (ant.) *barbastregio*, *barbastelo*, *barbastrigo*, *barbastrillo*;

Tyrol (Ital.), *barbustéll*. The reference of several names from the dialects of Corsica and Sardinia to that of the Basques may meet with some opposition. We are glad to read the references to Homer, and to find due recognition of his observations on natural objects. This is not the first of these interesting contributions from Dr. Major's pen, and it is to be hoped that his researches in European Miocene Mammals, on Samos and on Madagascar will yet leave him time to favour us with more of this laborious and interesting philology, the greater part of which is the result of personal investigation in the localities themselves.

IN the June issue of the *New Review* the Rev. S. A. Barnett makes some remarks on University Extension Teaching which are of interest as regards Natural Science. The Societies are just now threatened by the demand for popular teaching. Signs are not wanting that the popular lecturer is supplanting the thorough teacher, and while the former fills the largest hall in the neighbourhood, gives his twelve lectures, gets in fees which cover expenses, and satisfies everybody, the latter, "who handles his subject humbly and would make his students humble" and eager to learn, draws small classes and hardly gets employment. University teaching, says the writer, must dare to be unpopular, sending its teachers not to meet but to create a demand. "One of the best teachers in East London, whose mark remains after ten years, never drew a large class and never was popular; but he was thorough in his work, a master of his subject, and by his enthusiasm made others enthusiastic." Of course, this means that University teaching must be endowed.

Another danger is the absence of organisation. "Each society keeps, as it were, a shop, of which its lectures are the stock, and they are labelled with attractive titles. Active local secretaries for country towns or London districts come to the shop to buy, and are often led to the purchase only by appearances." There is thus a want of continuity, and the practice of taking "tit-bits" here and there is far too prevalent.

A concerted plan of action between the three great Societies and the establishment of definite series of courses stretching over two or three years would avoid the serious waste of time and effort which under existing conditions must sometimes occur.

IN one respect, the second Romanes' lecture at Oxford, like the first, was disappointing. Professor Huxley, like Mr. Gladstone, has a great reputation for the manner and form as well as for the matter of his addresses, and many of the audience of this second lecture, like many of the audience of the first, came expecting a brilliant display of the arts of oratory; but the Sheldonian theatre is among the worst

auditoria in the world, and during the greater part of the lecture those not immediately in front of the lecturer had some difficulty in hearing. We notice elsewhere the matter of the lecture, which has since been printed and published by Macmillan & Co.

The Rev. A. C. Waghorne, late of New Harbor, Newfoundland, has a collection of Newfoundland and Labrador plants for disposal. After 17 years' labour as a missionary, he is obliged by ill health to retire, for a time, from regular clerical work, and, being entirely without means of subsistence, hopes to derive some income by the sale of his plants. He is not himself a botanist, but his plants have been named by Messrs. Macoun, Warnstorf, Vasey, Bailey, Farlow, Hervey, Bebb, Underwood, and Eckfeldt. He proposes to issue complete lists of all he has collected in Newfoundland and on the Labrador, and to distinguish those of which he has material to spare. He hopes to have his list of mosses and lichens, at least, ready this month; the rest will probably not be prepared till the winter. A list of Sphagnaceæ has already been issued. As Mr. Waghorne will spend the summer in Labrador, applications for specimens should be made to the Rev. J. H. Bull, Whitbourne, Newfoundland.

I.

Recent Researches on Plant Nutrition.

IT was well-known before 1771 that a candle, in burning, vitiates the air, and on that account will not continue to burn in a closed air-space; but Priestley, in his "Experiments and Observations on different kinds of Air," records for the first time experiments made about this date which show that the restoration of air thus vitiated can be brought about by the intervention of plants.

Perhaps it was, to some extent, by accident that he was led to try the effect of placing a sprig of mint under a glass jar standing over water. The sprig he observed continued to grow for some months, and after the experiment the air inside the jar was found to be capable of supporting the combustion of a candle, and a mouse placed in it showed no signs of inconvenience. This was considered a remarkable fact, since it was to be expected that as air was known to be necessary for the support both of vegetable and animal life, the effect on it by the life-processes would be the same in both cases—in one case, deterioration was known to take place, and in the other, the same results, it was thought, ought to follow. The fact that a candle would burn in air which had supported plant-life for some time seems to have suggested to him the idea that possibly air injured by processes of combustion may be restored by the action of vegetation, and he accordingly devised experiments to test this hypothesis.

Sprigs of mint and spinach were enclosed in air in which a candle had been allowed to burn itself out, and it was found that the air was restored to its original condition, so far as combustion was concerned, in from two to eight days.

The processes of combustion and respiration were not understood at the time. Priestley seems to treat them as quite distinct, and again goes on to flatter himself that he has "hit upon one of the methods employed by Nature" for the restoration of air vitiated by *animal respiration*.

That some great operation was continually being carried on in Nature for the restoration of air rendered noxious by breathing was obvious, and Priestley, like many others, had tried various experiments in order to elucidate the matter—absorption by the earth, sea, and fresh-water, condensation by pressure, action of various gases, *e.g.*,

sulphur dioxide, as well as the influence of light and heat. All these seemed to yield no definite results, but ultimately the action of plants was found to be the chief cause. Mice were allowed to die in a closed glass vessel, and the confined air was then divided into two parts, and enclosed in glass vessels placed upside down over water, so that no air could enter or escape. Into one, sprigs of mint were introduced, and after eight days a mouse placed in it lived perfectly well, whereas, in the other vessel not so treated, mice died almost instantly.

By many experiments extending over two or three years, the reversal of the effects of animal respiration by plants was established and also the discovery made that green aquatic plants placed in sunlight in water containing "fixed air" (carbon dioxide), give off "dephlogisticated air" (oxygen). When the evolution of oxygen stopped, the introduction of fresh-water was followed by a brisk development of more bubbles, thus supporting the view that the oxygen came from the "fixed air" dissolved in the water, and not from the leaf.

Ingenhousz, in 1779, confirmed and extended Priestley's observations. The latter had suggested that the main purifying effects upon the air were due to the mere growth of the plant, but Ingenhousz conclusively proved that the influence of the sun's light upon the plant was an essential factor; in darkness, although kept at the same temperature as during the daytime, no purification took place, but rather the reverse.

Senebier, working independently about the same time as Ingenhousz, went over the same ground and laid stress upon the fact that only the green leaves give off oxygen in sunlight, and also stated more precisely that the amount of oxygen evolved was dependent upon the amount of carbon dioxide present in the water used, distilled water yielding practically no gas at all.

The observations, so far, had been chiefly qualitative in character, and it was not until 1804 that De Saussure's quantitative investigations were published.

By this time Lavoisier's famous researches had given an intelligible account of the processes of combustion and respiration—the composition of carbon dioxide was ascertained and the part played by oxygen in producing it was fully understood. The more extended use of the balance had also asserted the indestructibility of matter, and under the new *régime* progress became possible in all branches of science.

De Saussure, taking advantage of the facts and spirit of this new chemistry, introduced accuracy and terse completeness into his work. Various species of plants were placed in air of known volume and composition, and after exposure to sunlight for thirty-six hours the air was examined and found to have been altered in composition. The volume remained the same, but the carbon dioxide had disappeared and a nearly equal amount of oxygen had been substituted for it.

He also established the absolute necessity of carbon dioxide for plant growth, pointed out its injurious nature when present in more than comparatively small amounts, and, finally, made the most important discovery that, while the decomposition of carbon dioxide and exhalation of oxygen are going on in sunlight, the plant is increasing considerably in dry weight. This increase is, moreover, greater than can be accounted for by the fixation of carbon alone, the excess being due to the simultaneous fixation of the elements of water—hydrogen and oxygen—supplied from the ground through the roots.

With all this accumulated knowledge, it is somewhat difficult to understand why chemists and plant physiologists did not at once begin to inquire into the nature and composition of the product first formed in green leaves as a result of the processes described. The whole question of carbon-assimilation by leaves had been well opened, but the experiments were regarded by many of the chief workers in this field as having not even the remotest connection with nutrition of plants, and were consequently cast aside, or at least neglected and almost forgotten. This was largely due to preconceived notions respecting plant food, and the state of chemical knowledge at the time was such as to check progress. The early Aristotelian teaching—that the sole food-substance of all plants was "humus"—prevailed, and chemists were almost compelled to adopt this view because of their conceptions regarding the formation of organic compounds. Animal, vegetable, and mineral chemistry had been found to be an inconsistent classification, as some compounds belonging to the first two groups were found to be identical; but a more disastrous division into organic and inorganic chemistry took place, the latter dealing with elements under the influence of physical and chemical forces as at present understood, whereas into the former was introduced a "vital force" which helped to get over difficulties otherwise not amenable to treatment, and at the same time made attempt at a reasonable explanation somewhat superfluous. It was dogmatically asserted that substances formed under the influence of the vital principle could not be produced artificially, and, unfortunately, Wöhler's synthesis of urea in 1828 was incomplete, and remained for a long time the only case tending to support an opposite opinion. The existence of such a force, which was even capable of the creation of plant-ash out of nothing, made careful observation unnecessary, and it was not until after the complete destruction of the humus-theory of plant nutrition by Liebig in 1840, and Boussingault a little later, that the mind was free to look at the significance of the work of the early experimenters.

From this period down to the present time the assimilation or preparation by plants of organic compounds from simple substances, such as carbon dioxide, water, and ammonia, supplied to them from the surrounding atmosphere and soil, has been the subject of numerous and elaborate investigations. The recognition of the decomposition of carbon dioxide with elimination of oxygen by the

green parts of plants as an assimilatory process, dates from the beginning of the century; the essential importance of light was also recognised by the early workers, but it is to Sachs that we owe the discovery of the connection between this carbon-assimilation and the production of a definite substance—starch—in the chloroplasts of the leaf.

The occurrence of starch granules in the chloroplasts was made known by von Mohl in 1837, but Sachs, in 1862, observed that it was induced by the same conditions as those known to be necessary for the decomposition of carbon dioxide by plants, namely, exposure to light, and his memoirs of 1862–4 deal with the influence of light on starch production in the chloroplasts. He shows that where carbon dioxide is being absorbed there is a constant production of starch when the plant is exposed to sufficiently bright daylight, a subsequent disappearance and removal of this starch from the leaf at night, and for the first time explains the connection between carbon-assimilation and starch production by the leaves. Godlewski, in 1873, strengthened Sachs' conclusions by the demonstration that no starch-grains are formed in the leaf-chloroplasts when carbon dioxide is missing from the surrounding atmosphere, even when the plant is exposed to bright light.

When decomposition of carbon dioxide and exhalation of oxygen is going on, starch in nearly all cases makes its appearance in the green chloroplasts of the leaf, yet Sachs' work does not show that starch is the immediate and direct product of this assimilation, although the fact that the volume of oxygen given off equals the volume of carbon dioxide absorbed was at first taken as a support for this hypothesis. That a complicated compound, such as starch, should be actually formed directly from carbon dioxide and water was highly improbable, and since Sachs' first papers there has accumulated a large amount of evidence pointing to the formation of some much simpler carbohydrates, which are transformed into starch by the chloroplast, probably only when they are in excess of the immediate requirements of the cell for its own nourishment and respiration—that starch is, in fact, always a reserve material and is only the first visible product in a large series beginning with carbon dioxide and water.

Böhm (1877) showed that starch can be formed in the chloroplasts from materials which have been elaborated elsewhere than in the cell in which starch-production is going on, and Schimper (1880) paved the way for further research in this direction by his discovery of the starch-forming corpuscles or amyloplasts in parts of plants not green (tubers, stems, &c.) and their morphological identity with chloroplasts. These bodies are colourless and are concerned with the formation of starch out of ready-formed sugars supplied to them, and can be changed into chloroplasts by exposure to light in many cases.

Schimper's conclusion that the chloroplasts of the leaf parenchyma have not the power to produce starch except by assimilation from

the atmosphere was shown to be incorrect by Meyer (1885–6), who found that starch is readily formed by the mesophyll chloroplasts when the leaves are floated on solutions of dextrose, levulose, cane-sugar, galactose, and even mannite and glycerine.

Baeyer's suggestion that the first formed product of the carbon assimilation is formaldehyde—a compound which undergoes easy condensation into sugar-like substances—has been considerably supported by recent work on the sugars, notably by Emil Fischer's syntheses of dextrose and levulose, although attempts to feed chloroplasts with aldehyde or its derivatives have met with only partial success.

The most recent and at the same time one of the most important contributions ever made to the study of plant-metabolism, is that of Messrs. Brown and Morris, communicated to the Chemical Society in April last. In their paper they deal with the occurrence of starch, diastase, and sugars in leaves, and the work will undoubtedly take high rank in the annals of plant physiology.

Sachs, in 1884, endeavoured to determine the weight of starch produced during the day by estimating the dry weight of two definite equal areas of the leaf, taken symmetrically from opposite sides of the midrib, one in the morning and the other in the evening after the day's exposure to sunshine. The assumption was made that the differences in dry weight were due to gain in *starch*, and the results showed in the case of a sunflower an increase of 9·14 grains per square metre in ten hours. Similar experiments carried out on plucked leaves with their petioles immersed in water yielded greater increase in weight, owing to the dissolution products of starch not being able to flow into the stem under these circumstances.

Messrs. Brown and Morris point out that this method merely indicates the *total assimilated products* which are manufactured under the given circumstances, and not necessarily the amount of *starch* produced. Sachs thought otherwise, as he assumed that all the assimilated products of the leaf must at one time or other pass through the form of starch in the chloroplasts, an assumption for which there is no evidence. These observers bear testimony to the applicability and accuracy of Sachs' dry weight method of estimating the rate of assimilation, and go on to determine the amount of starch which is present at any one time in the leaf, and the proportion which it bears to the total products of assimilation.

Leaves were rapidly dried at 75–80° C., or killed by the action of chloroform vapour, and then finely powdered and the fats and chlorophyll extracted with ether. Ten grams of the powdered leaves were then taken and extracted with alcohol; the starch in the powder was then gelatinised by hot water, and finally determined by estimation of the maltose and dextrin produced after the action of diastase upon it for about two hours.

Two different batches of Tropæolum leaves picked after the same amount of isolation were found to contain 6·408 and 6·545 per cent. of starch respectively, results which are representative of the accuracy which can be attained by their method.

Estimation of the starch in the leaves of sunflower while attached to the stem, at five a.m. and again at five p.m. on a fairly bright day, showed an increase of 1·4 grams of starch per square metre during this period, while the total assimilation-products actually formed during this time, estimated from the dry weight of similar leaves separated from the stem and their petioles immersed in water, was over twelve grams per square metre. It is here seen that if Sachs' view is correct—that all the assimilated materials pass through the form of starch—the formation of the latter substance and its dissolution must be carried on at an exceedingly quick rate. It is, however, far more probable that much of the assimilated material passes out of the leaf into the stem of the plant without ever being organised into starch by the chloroplasts.

Messrs. Brown and Morris go on to discuss the occurrence and periodic variation in the amount of diastase present in leaves, and in this direction they have achieved much success. Incidentally, it may be observed that the whole of their work arose out of the discovery of diastase in dry hops when they were prosecuting an enquiry into the cause of secondary or "cask fermentation" in beer.

The function of the ferment diastase in the breaking down of starch into the soluble substances sugar and dextrin when seeds are allowed to germinate, has been recognised almost from the time of its discovery and isolation by Kirchoff, Payen and Persoz, and Dubrunfaut at the beginning of this century, and a study of this dissolution of starch led to the generally expressed belief that the same or a similar ferment is concerned with the disappearance of starch from the leaf chloroplasts.

Attempts, however, to isolate diastase from green leaves were not made until about 1877, when Kosmann and Baranetzky took up the work. Small traces were found in the leaves of various species of plants by both observers, and Baranetzky expressed the opinion that the smallness of the amount present at any one time was to be attributed to its being used up as fast as it is produced.

Brasse, in 1884, also conclusively proved its presence in leaves, though Sachs in the same year, in his paper on assimilation, was unable to decide whether the dissolution of starch in the leaf is due to some special power of the chloroplast, or to soluble ferments.

Wortmann, in 1880, from experiments of the most questionable character, concluded that diastase is missing from practically all leaves, and even when present plays no part in starch dissolution, the process being attributed by him to the action of the living contents of the cell.

Messrs. Brown and Morris find, however, that, instead of leaves

possessing little or no diastase, there is always present more of this ferment than is sufficient to transform all the starch they can ever contain at one time, and in some cases the amount is such as would transform a quantity of starch more than equal to the whole dry weight of the leaf itself.

The conflicting results previously obtained respecting this subject are almost entirely due to the fact that although diastase is soluble in water, it cannot readily be extracted from the leaf, on account of the tenacity with which it is held by the protoplasm; the presence of considerable amounts of tannin also renders it insoluble. However, by specially drying the leaf, and using the powdered tissue itself, it is possible to demonstrate the presence of leaf diastase in all cases, and these experiments give proof of its identity with the malt ferment; the production of the sugar maltose and dextrin from soluble starch is brought about by both alike.

The diastatic activity of the leaves of various species of plants was compared, the results being very remarkable. The leaves of leguminous plants stand far ahead of all others in this respect, the garden pea heading the list. The relative diastatic activities are stated in the amount in grams of maltose, which 10 grams of the air-dried leaf will produce from soluble starch in 48 hours at 30° C. Twenty-six species were examined, and the following are typical results:—

Pea (*Pisum sativum*)	240·30
Scarlet Runner (*Phaseolus multiflorus*)	110·49
Clover (*Trifolium pratense*)	89·66
Vetch (*Vicia sativa*)	79·55
Potato (*Solanum tuberosum*)	8·16
Sunflower (*Helianthus annuus*)	3·94
Onion (*Allium cepa*)	3·76
Cotyledon umbilicus	4·61
Funkia sinensis	5·91
Hymenophyllum demissum	4·20

The work points to a connection between starch-forming power and the diastatic power of leaves, but must be extended before any general statement can be given.

Changes in diastatic power of different portions of the same leaf at different times of the day prove that the ferment increases as fast as the leaf is being depleted of its starch and other assimilated products. Considerable accumulation takes place in the dark. They believe that the secretion of diastase is only carried on by the protoplasm when the soluble nutriment of the cell has been used up or carried out into the stem. At this starvation point diastase is secreted in order to bring about the supply of soluble food-materia from the reserve starch in the chloroplast.

The last part of their memoir is concerned with the sugars of the leaf, and this part of the work indirectly supports the unexpected view that cane-sugar is the first sugar to be synthesised in the assimi-

latory process, and at the same time establishes almost beyond doubt that the starch dissolution in the leaf is mainly brought about by the action of the diastase which they have proved is so generally present.

It is in the determination of the nature and variation in the amount of the different sugars present in the leaves of plants that Messrs. Brown and Morris have laid the foundation of a more complete and extended knowledge of the complex chemical changes occurring in plant carbon-assimilation, and their work may be characterised as the first which has placed the subject on more than a hypothetical basis.

When diastase acts upon starch the result is the formation of a sugar—maltose—and dextrins, which latter on further action are also changed into maltose. If, therefore, this ferment is concerned in the dissolution of starch in leaves it ought to be possible to prove the existence of maltose in these organs. This they have satisfactorily accomplished by processes which are too technical to be introduced here, but about which there can be no doubt. The only other sugars found to be present in Tropæolum leaves were cane-sugar, dextrose, and levulose. Simpler pentoses were looked for but none discovered. Experiments were afterwards directed towards the quantitative determination of these sugars in the leaves at different times of the day and night, in the hope that some light would be thrown on their function, translocation, and genetic relation to each other, and to the carbohydrate starch, and to ascertain something about the sugars which stand between the first products of assimilation and starch and those which are to be looked upon as derived from the latter by chemical transformation.

A considerable number of leaves of Tropæolum were picked at 5 a.m. and separated into two batches. One set (*a*) was dried at once and the carbohydrates estimated, and the leaves of the other set (*b*) were placed with their petioles in water and exposed to sunlight until 5 p.m., and then a similar series of leaves (*c*) was picked after exposure to sunlight during the same period, but still attached to the plant. The starch and sugars of these three samples were determined with the following results :—

	a	*b*	*c*
Starch	1·23	3·91	4·59
Sugars—			
Cane-sugar	4·65	8·85	3·86
Dextrose	0·97	1·20	0·00
Levulose	2·99	6·44	0·39
Maltose	1·18	0·69	5·33
Total sugar percentage on dry leaf	9·79	17·18	9·58

From (*b*) and (*c*) it is seen that the production of starch in cut leaves does not go on so rapidly as in leaves which are allowed to remain attached to the plant.

Sachs first noticed that the dry weight of a plucked leaf increases considerably when isolated and its petiole placed in water, and this increase is seen to be due mainly to the accumulation of sugars, not starch. The total sugars in (*b*) have been nearly doubled, and this is mainly due to the increase in cane-sugar, a result which militates against the generally received opinion that a glucose is the principal "up-grade" sugar first formed by the leaf.

The changes which the sugars undergo when assimilation is prevented are well brought out by the following experiment. A considerable number of leaves were plucked in the afternoon of a fairly sunny day, and dried immediately (*a*). Another similar set (*b*) were taken and placed in the dark for twenty-four hours, their stems being dipped in water. The result of the analysis gave :—

	(*a*)	(*b*)
Starch	3·693	2·980
Sugars—		
Cane sugar	9·98	3·49
Dextrose	0·00	0·58
Levulose	1·41	3·46
Maltose	2·25	1·86
Total sugar percentage in dry leaf	13·64	9·39

Total loss of sugars and starch in (*b*) = 4·96 per cent.

The loss or destruction of starch and cane-sugar is due to respiration. The disappearance of the cane-sugar has been accompanied by increase in levulose. Seeing that the conditions of the experiment preclude the possibility of formation of levulose by assimilation, this fact points to the conclusion that the cane-sugar is first inverted, and the resulting dextrose and levulose are used up at uneven rates by the respiratory processes, the former, together with a little maltose, contributing chiefly for this purpose. The experiment, at the same time, renders it almost certain that the increase of levulose in (*b*), previously described, is derived from cane-sugar inversion, and not from direct assimilation.

Looked at from all points of view, Messrs. Brown and Morris's results undoubtedly point to the conclusion, so far as Tropæolum is concerned, that cane-sugar is the first sugar to be synthesised as a result of the carbon-assimilation by the leaf, and that only after a certain concentration of this substance in the cell-sap is starch formed as a more stable reserve material. In the leaf, cane-sugar suffers inversion, and ultimately passes from cell to cell and out into the stem as dextrose and levulose, the starch being at the same time translocated as maltose.

The whole work is full of suggestion, and is a model of consummate skill and accuracy. Plant physiologists have reason to be grateful for the improved methods of research devised by these two workers, and the foundation which has been laid for further investigation, as well as for the results obtained. Taken in conjunction with the extraordinary haziness manifested in the chemistry of

even modern plant physiology, the work tends to emphasise the necessity that those who would further progress in this department of biology must first be chemists.

Considering the great labour and patience which these researches must have involved, it may, perhaps, seem ungrateful to express regret that the function of chlorophyll meets with no consideration. Notwithstanding the researches of Engelmann, Pringsheim, Timiriazeff, and many others, this part of the subject is little understood, and now that the morphological and physiological identity of the coloured chloroplast and colourless amyloplast is completely established so far as starch-production from already assimilated materials is concerned, the quite separate function of constructing a proto-carbohydrate from carbon dioxide and water by the former, due to its possession of chlorophyll, is of especial interest.

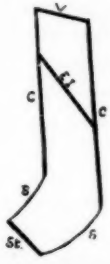
J. PERCIVAL.

II.

The Respiration of Birds.

JOHN HUNTER, I believe, held that birds did not draw breath during flight, but merely used the air stored in the sacs. Extraordinary as this view may seem, he was led to adopt it by what is a very real difficulty, namely, that the movement of the breast in breathing would seriously derange the machinery of flight. Mr. Edmond Alix, in his *Essai sur l'appareil locomoteur des Oiseaux*, gives what I believe is the right solution of the problem, viz., that the bird during flight moves its back, not its breast, up and down in the act of breathing; but he does not explain how this is effected. My own investigations have led me to the conclusion that the muscular movements necessary to flight themselves to a great extent bring about the enlargement and contraction of the thoracic cavity without which respiration cannot take place. The muscle called the latissimus dorsi, which arises from the vertebræ, and, after passing over the scapula, is inserted in the humerus, raises the backbone during the down stroke of the wing, bringing the bird's body into the position which is required for horizontal flight; and not only is the backbone raised and brought to, or nearly to, the horizontal, but at the same time the ribs are straightened, and this causes an expansion of the air-sacs. The effect of this raising of the back may be seen if a bird is suspended by its backbone, when the weight of the sternum and the breast muscles hanging upon the ribs causes them to straighten out at the junction of their costal and sternal portions. The muscles, also, which pass downwards to the ribs from the posterior ends of the scapulæ, will help towards the same result, and, besides that, will broaden the roof of the thoracic cage, the upper part of the rib tending to become more horizontal when the lower part is raised. The action of these last-named muscles is assisted by the movement of the scapula. It will be found that during the down stroke, when the front margin of the wing is lower than the hind margin, so that the undersurface of the wing looks downwards and backwards, the anterior end of the scapula is depressed very slightly, and this causes a considerable raising of the posterior end. Thus in birds, as in many crustaceans, progression itself aids greatly the process of respiration. Another point worth noticing is that in this the great pectoral plays an important part, for it is due to the great strength of this muscle

that the contraction of the latissimus dorsi causes a movement of the body and not of the wing. All possible work is put upon the pectoral muscles, so that the centre of gravity may be low down, a point of great importance in a flying-machine; but though the flight muscles help so largely towards respiration, of course much is done by what are commonly spoken of as the respiratory muscles. The levatores costarum, which I have found very highly developed in the domestic pigeon, arising from the vertebræ, passing backwards and attaching to the ribs some way down, tend to make the upper part of the rib horizontal, thus broadening the chamber beneath. The triangularis sterni, which arises from the inside of the sternum, from its anterior lateral end, and attaches to the sternal ribs, works towards the same object from below. The action of the external intercostals is not so easy to understand. In man they raise both the ribs, which they connect, and at the same time raise the breastbone; but in birds the pectoral muscles render the sternum heavy, and, what is far more important than this, the weight of the body hanging upon the wings during flight, and the pressure of the wings inwards upon the coracoid bones and clavicles, must make the breastbone practically immovable. What, then, will happen when the external intercostals contract? It must be remembered that the contraction of a muscle tends to shorten the distance between its two ends. The muscular band, passing obliquely back and downwards, will lower the front rib to which it is attached, and raise the hinder; the loose muscular connection of the vertebral column with the shoulder blades allowing some depression of its anterior and a corresponding raising of its posterior part. Moreover, the backbone of most birds that I have examined bends downward easily, and through a considerable arc just anterior to the ilium. The raising of the hindmost ribs which articulate with the vertebræ behind the point where the bend takes place, will aid the vertebral muscles in straigthening the back. The accompanying diagram illustrates the working of the external intercostals.



c. = Costal rib.
e.i. = External intercostal muscle.
s. = Sternal rib.
st. = Sternum.
v. = Vertebral column.

The contraction of the muscle will lower the anterior and raise the posterior rib.

Wishing to test these conclusions by experiment, I suspended a freshly-killed pigeon by its wings, and inflated the air-sacs by means of a blowing tube. The backbone, a little in front of the thigh

joint, moved rather more than half-an-inch—the movement of the sternum being almost too slight to measure. I do not wish to represent this experiment as one of much value. However, the conditions of flight were so far reproduced that the weight of the body was hanging upon the wings, and so hindering the movement of the breast, while leaving the back free; but there was none of the pressure—which during flight must be very great—of the wings upon the coracoid bones and clavicles. But would not the only effect of this pressure be to render the sternum and the bones united with it still less ready to move?

It will be observed that I have said nothing upon the vexed question of the action of the internal intercostals. They are so weak that the result of their action, whatever it may be, cannot be a large factor in the problem of respiration. When a bird is standing or running, it is obvious that the back is fixed to the legs, so that it cannot rise and fall. Clearly, then, the process of respiration must be different, and if a bird be watched when it is filling and emptying its air-chambers in order to utter a loud note, the moving forward of the breast may be easily seen. As I have said, the main obstacle to its motion during flight is, not its weight, but the tension and pressure at the shoulder joint. With regard to the abdominal air-sacs, the raising of the hinder-quarters by the legs, when the bird is standing, will itself expand them. The air will be expelled by the contraction of the abdominal muscles, which will draw the sternum inwards. In connection with this, I may mention that Mr. F. E. Beddard has found the oblique septum muscular in the puffin, and I myself have confirmed the observation. When a bird is sleeping with its breast resting upon the perch, or lying upon the ground with nearly all its weight upon its breast, it must adopt a method of breathing similar to that employed in flight. Often geese and other birds, while lying on their breasts, will exert a great deal of voice-power, and then the rising of the hinder part of the back is distinctly visible. The fore part may appear to rise a little, but this appearance is due, I think, to the raising of the ribs by the levatores costarum. The legs, apparently, have no weight upon them, so that the back is not held down as in standing. The muscles called into play must be the external intercostals and the triangularis sterni.

F. W. HEADLEY.

III.

Observations on Certain Marine Animals.

I.—A New Protective Device of *Maia squinado*.
II.—Colour Assimilation among Fishes.
III.—A Fighting Stratagem of the Crawfish (*Palinurus*).
IV.—Abnormalities in *Haliclystus* (*Lucernaria*).

I.—A New Protective Device of *Maia squinado*.

I HAD occasion recently to watch closely the habits of the large Spider Crab, *Maia squinado*, while in captivity in the Aquarium tanks of the Jersey Biological Station. The first individual obtained, a female, was temporarily placed in a large bare tank, unfurnished with either boulders or sea-weeds. A thin layer of fine shingle about an inch in depth covered the bottom. *Maia* for a while was very restless, seeking, apparently, for a suitable place of concealment. Finding none, she at length took up a position in the centre of the tank, scratching a hollow in the shingle wherein to lie. After a short interval of rest she began an admirable plan of concealment. First with one chela and then with the other the crab selected and lifted carefully pebble after pebble and deliberately placed them, closely fitted together, upon the surface of the carapace, the rough spinous nature of this being admirably suited to hold them in position. Rarely a pebble would fall off, so carefully did *Maia* poise them and so steady did she hold her body. At the end of a quarter of an hour the red spiny back was converted into a little mound of pebbles, and the crab absolutely hidden.

Now *Maia*, in common with several allied species, such as *Pisa tetraodon*, *Acheus cranchii* (Spence Bate *Ann. and Mag. Nat. Hist.*, 1866), and *Stenorhynchus*, etc., has the habit of decorating and trimming the carapace and limbs with scraps of weed hooked often quite artistically on to the recurved bristles that beset these parts. This with obvious protective intention. But *Maia* at home seems never to frequent pebbly localities. Its habitat is in the sand and under the weedy, root-matted edges of the *Zostera* banks. Hence it is reasonably to be inferred that the protective device described above was independently thought out to meet the special exigencies of the occasion. Several other *Maia* subsequently placed in the same tank performed precisely the like operation.

It is noteworthy that all these were either females or immature males; the adult males are normally very large, usually at least twice the size of females, and are provided with long and powerful chelæ, which make them independent of the subterfuges adopted by the weak small females. An interesting point, too, is that the weak chelæ of these mimics are quite smooth, without the recurved bristles of the other limbs, and hence are unlike them, never having any weedy trimmings.

II.—Colour Assimilation Among Fishes.

We already know a good deal about this, especially among the flat-fishes, so the following instances but go to swell an already long list. Still, these are so striking as to be worthy of permanent record.

Two tanks were used for experiment, one with dark background and bottom, well shadowed; the other bright, with a white mottled sand bottom. Several of the marine stickleback (*Gasterosteus spinachia*) were placed in each. To sum up the result briefly, those in the dark shadowed tank remained practically unchanged in colour, but those in the light-coloured tank had in greater or less degree lost their brightness and intensity of colouring. The beautiful gold bronze lustre so characteristic of these sticklebacks was lost, and the backs were mottled black and white, contrasting strangely with the nearly unbroken yellowish black of the dorsal surface of their friends in the dark tank.

In the dark tank had also been placed a number of Wrasses (Labridæ), and these showed fading all round, most marked in the bright greens and scarlets. As these colours are usually in combination with brownish marking, the fading of the bright hues meant a close approximation to the brown appearance of the bare conglomerate forming the rockwork of the tank. One fish especially beautiful at first—of a most brilliant scarlet and brown—faded to a dirty combination of pale olive green and brown, scarcely recognisable had the fish not been marked in a distinctive manner at the beginning of the experiment. The whole of these colour changes were effected within the remarkably short period of a week.

It may be that these instances of colour assimilation carry the key to the problem of colour variation or rather mimicry in the prawn *Hippolyte* (*Virbius*) *varians*.

Plaice (*Pleuronectes platessa*) have also shown rapidity of colour-change much more marked than I was prepared for. Some that were placed in a large shallow tidal pond where the colour of the bottom varies considerably and where a portion is often in deep shadow, show change from a uniform grey to a well-marked and intensely dark blotched appearance within a few seconds. Indeed, it is quite chameleon-like, so quickly is the transformation effected. In ordinary tanks where the light and the colour of the sand are stable, the plaice soon take the exact colouring requisite, and retain it without alteration so long as they remain in the particular tank.

III.—A Fighting Stratagem of *Palinurus*.

The Common Crawfish (*Palinurus vulgaris*) has many points of interest, and not the least curious is his plan of combat when matched with a powerful antagonist. Without chelate limbs, he seems weak and defenceless. One is at first inclined to commiserate this apparent want of means alike of offence or defence, especially in comparison with his kindred, the lobsters, armed so well with powerful seizing chelæ. That he had means of defence seemed probable; but it is only within the last few days that this was satisfactorily demonstrated. Without any particular intention in view, we had dropped a medium-sized lobster into the tank containing two large *Palinurus*. At first no sign was given, but in a little while we were attracted by a loud noise as of a skirmish, and had an inimitable object-lesson in Crawfish warfare. The larger of the two Crawfish apparently resented the intrusion of the lobster, and was determined upon ejection. There was a good deal of preliminary sparring, but the fight which promised to be protracted ended suddenly in a most unexpected manner. Making a sudden twist, the Crawfish got above the lobster crosswise, and suddenly snapping his powerful tail, jammed the body of his antagonist in the fold, thus impaling him on the sharp downward spikes of the pleura that are such conspicuous objects in a side view of *Palinurus*. The lobster was put quite *hors de combat*, for his body was terribly mutilated by the sharp spines, which had pierced his armour as though it were tissue-paper. Besides this instance, cases are known where persons, incautiously handling the Crawfish, have received wounds on the arm inflicted by similar sudden flap of the tail.

IV.—Abnormalities in *Haliclystus* (*Lucernaria*) *octoradiatus*.
(Preliminary note.)

This year, having occasion to examine a very large number of the Lucernarian most common in these seas, viz., *H. octoradiatus*, I was surprised to find a very large proportion to possess more or less strongly-marked abnormal features. These were divisible into two groups, the first where the colleto-cystophores were malformed, the second where these organs or the grouped tentacles were above or below the normal number eight.

The specimens gathered were in two lots, the one taken in February and March comprising large adult individuals ¾ to 1 in. in diameter, the other collected in the beginning of June, and made up of half-grown individuals, averaging half-an-inch across, but in which the ova, etc., were well advanced.

The malformed colleto-cystophores showed several interesting points, but the only one I wish to dwell upon now was a common case, where the summit of the organ showed very obvious homology with the ordinary capitate tentacles. In many the resemblance was

but faint—a slight rounded swelling at the apex—with presence of a few of the ordinary nematocysts of the tentacles. From this stage there were all gradations up to a few rare instances where the apex of the c.-cystophore bore a perfect capitate tentacle precisely the same in structure to the normal tentacle, saving that the stalk was extremely short, just equal in length to the diameter of the head. All the examples of this variation were furnished by the lot gathered in June. The proportion was surprising. Out of 118 specimens examined but 40 were without thi abnormality in the c.-cystophores.

14	showed	one	colleto-cystophore	with	tentacle-crowned	apex.
15	,,	two	,,	,,	,,	,,
15	,,	three	,,	,,	,,	,,
9	,,	four	,,	,,	,,	,,
8	,,	five	,,	,,	,,	,,
5	,,	six	,,	,,	,,	,,
4	,,	seven	,,	,,	,,	,,
8	,,	all the	,,	,,	,,	,,

Otherwise these specimens showed but little mutability. Two colleto-cystophores were doubled and one specimen had an extra group of tentacles, while another lacked one.

In the larger specimens taken earlier in the year, the tentacle-crowned c.-cystophore phase was not observed, but there was extreme want of symmetry. Quite 33 per cent. showed variation in the number of colleto-cystophores or in the groups of tentacles. The greater number (more than half) were cases where the marginal organ was wanting in the space where normally it would be found; the others were instances of excess number of tentacle groups (accompanied usually by the presence of an equal number of excess colleto-cystophores) or of duplication—"twinning"—of one or two of the last-named bodies.

The conclusions to be drawn from the last mentioned abnormalities are obscure, but those where the colleto-cystophores bear the papillate appendix at the summit are certainly atavistic, explainable by the original derivation of these organs from ordinary papillæ.

JAMES HORNELL.

IV.

Recent Progress in Conchology.

SOME recently-published conchological treatises seem deserving of somewhat more than a mere passing notice in these pages, since they contain matter which deals with either the whole, or a large section, of the molluscan phylum.

To begin with, there is an interesting paper from the pen of M. Moynier de Villepoix (1) that furnishes an admirable summary of what is known concerning the formation and growth of the molluscan shell. It is not, however, confined to a summary, and among the new points which its author claims to have established is the mode of formation of the ligament in bivalves. This, it appears, is secreted by the epithelium of the dorsal suture, each of its constituent elements being formed by cells specialised for the purpose. With regard to his observations on the growth of the shell in *Helix*, we greatly fear that those relating to the special areas of secretion of the mantle, with the description of their cells, will have to rank as confirmatory only and not as discoveries, for if we mistake not these structures have already been dealt with some years ago by MM. Longe and Mer (2), the title of whose paper we miss from the valuable bibliography at the end of the memoir. Two other references seem also to have escaped the vigilance of the writer, namely Gray's principal and important paper on shell-structure (3), and the source of that naturalist's inspiration (albeit unacknowledged), Count Bournon's work on Calcite (4).

The next memoir to which we wish to allude is that by M. H. Fischer (5), a coming writer on molluscan anatomy and already noted for the careful nature of his work, who deals in a comprehensive manner with the morphology of the liver in the Gastropoda.

His principal results may be briefly summarised as follows:—In the Scutibranchs (*e.g.*, *Neritina*) the hepatic lobes of the embryo are equal and symmetrical. One genus only of the Prosobranchs, *Valvata*, which also resembles the Scutibranchs in possessing a bipectinate gill, displays the same regularity. In all other Gastropods the two lobes are unequal, either *ab initio* or soon after their formation, the left lobe being the larger. It sometimes happens in the adult (*Elysia*, *Arion*, *Buccinum*) that the balance is restored, but this acquired symmetry of a later stage has not the same morphological value that attaches to a like equality in the initial stages of the development of

that organ. The liver in Prosobranchs undergoes a process of evolution comparable to that of the other organs; but the subdivisions that could be established for the Pectinibranchiata on its variations would not entirely correspond with those founded on other characters, such as the radula, nervous system, kidney, or shell. Hence the difficulty of founding a classification on the sum of the characters, and the desirability—M. Fischer considers, since the liver is not suitable for the purpose—of basing a systematic arrangement on some single feature, such, for example, as the radula.

The classification of the Mollusca, especially from a phylogenetic aspect, has received of late very much attention, and quite a forest of genealogical trees have been constructed for this sub-kingdom, or portions thereof, by Von Jhering and others, to the great bewilderment of the unlucky student who attempts to thread their maze.

The most recent complete scheme is probably (there may be a later by the time this appears in print) that by Dr. P. Pelseneer (6), and it is a matter for regret, that while the privileged few have had author's copies for some months past, so that his table has been even incorporated in Simroth's new edition of the molluscan portion of Bronn's great work (7), the volume from which it was supposed to be taken has but just been made available for the many.

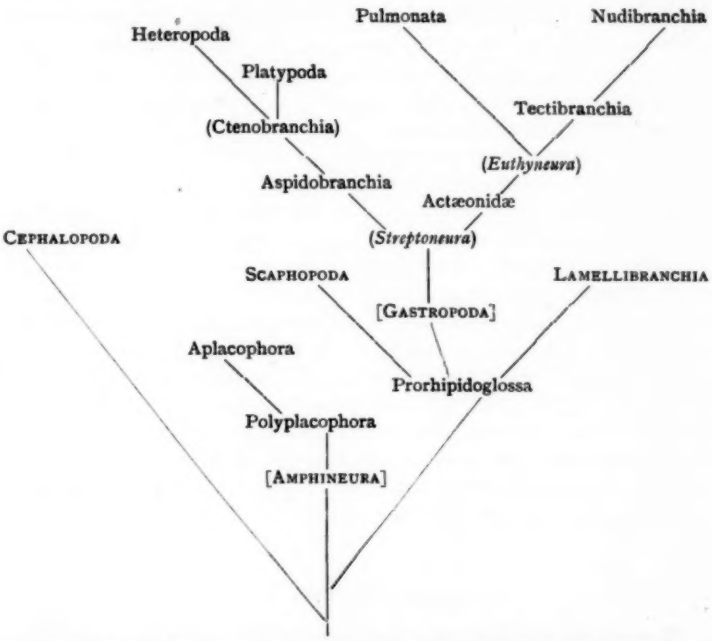
On looking at the scheme here reproduced in both its tabular and phylogenetic form (the latter modified in accordance with a later paper to be presently mentioned), certain points at once engage the attention: most of them, it is true, have been already set forth in minor communications, but the arrangement, as a whole, has not been presented before, and therefore it appears a fitting opportunity on which to call attention to them:—

Amphineura			Polyplacophora
			Aplacophora
Gastropoda	Streptoneura	Aspidobranchia	Rhipidoglossa
			Docoglossa
		Ctenobranchia	Platypoda
			Heteropoda
	Euthyneura	Opisthobranchia	Tectibranchia
			Nudibranchia
		Pulmonata	Stylommatophora
			Basommatophora
Scaphopoda			Solenoconcha
Lamellibranchia			Protobranchia
			Filibranchia
			Pseudolamellibranchia
			Eulamellibranchia
			Septibranchia
Cephalopoda			Dibranchia
			Tetrabranchia

In the first place, the Pteropoda as a class have disappeared, being merged with the Opisthobranchiata. They were originally classed as allies of this last-named order by De Blainville (8 and 9), who then used the term "Pteropoda" for certain of the Nucleobranchs

and *Argonauta*, whose shell in those days was not thought to be the product of the animal that occupied it. This arrangement, however, was never really adopted by conchologists, and it was not until 1886 that Boas (10) pointed out, on anatomical grounds, that the Pteropoda could not be separated from the Opisthobranchiata.

As one of the results of his researches in connection with the preparation of the "Challenger" Reports on the Pteropoda (11) Pelseneer was led to acknowledge the correctness of this conclusion, and it has been subsequently accepted by Professor Lankester (12) and adopted by Lang in his Lehrbuch (13). The latter authority, also, follows Pelseneer in his classification of the Pelecypoda (14), or Lamellibranchiata, to use a later and less preferable term, to which we note with



regret that our author reverts. These last he derives, as before, with the Gastropoda from a common stock—the hypothetical Prorhipidoglossa, but adds now as another branch from the same—the Scaphopoda. In this he is in accord with Plate (15), who, however, places their branch a little more directly on the main stem, between the off-shooting of those of the Pelecypoda and *Patella*. In a subsequent note on the genus *Actæon* (16), Pelseneer, agreeing with Bouvier (17), slightly modifies his scheme, and considers that *Actæon* is not only the common stock whence are derived the Pteropoda, Tectibranchiata, and Pulmonata, but also the link between the Streptoneura (=Prosobranchiata) and the Euthyneura (=Opisthobranchiata and Pul-

monata); for *Actæon* is streptoneurous, that is to say, possesses a nervous system in which the loop-like visceral commissure is crossed over in the form of a figure 8, and hence shows that the Euthyneura, in which the visceral commissure forms a simple loop, were in the first instance streptoneurous like the Prosobranchiata, and that their euthyneurity, if the word may be permitted, is the result of secondary displacement of the visceral hump from left to right. This retrograde displacement may possibly have been occasioned through the hermaphroditism of the animal, since the Streptoneura are all unisexual. Among the Streptoneura the Trochoid Rhipidoglossa are nearest to *Actæon*.

Another point of importance is the direct derivation of the Cephalopoda from the primitive stock before the other branches lead off. In thus opposing the Cephalopoda to the rest of the molluscan phylum, Pelseneer agrees, as he himself is careful to point out, with Giard, who advanced this view in 1876 (18). The grounds for this theory are to be found, not only in the anatomy, but also in the high antiquity of the class.

As to the source whence the Mollusca arose, this, Dr. Pelseneer thinks, must be sought in the Polychæta Errantia, or that group of the Worms to which, among others, the gaudy sea-mouse (*Aphrodite*) belongs; and, moreover, he is of opinion that the family Eunicidæ are, among the living representatives of that sub-order, the nearest, in the *ensemble* of their organisation, to the Mollusca.

Granting this conclusion, what then of the shell? We are tempted to speculate whether the power of specially secreting a calcareous covering may not be the revival of a dormant faculty (seeing that it is present in a collateral sub-order, the Tubicolæ, or Tube-building Worms), just as the individual offspring of higher creatures will at times present characters or display capabilities that have lain dormant in their immediate progenitors—an occurrence to which the term atavism has been applied.

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B. B. WOODWARD.

V.

The Museums of Public Schools.

I.—CHARTERHOUSE.

IT is an encouraging sign that the "Museum Question" has penetrated into the majority of our Public Schools, and that a desire is felt that the "old-curiosity-shop" type of museum should give place to an organised institution of real educational value. It will be granted on all sides that education is the primary object of all and particularly of School Museums.

The problem then presents itself—How ought a Public School Museum to be arranged to the best advantage of Public School teaching? To this question a cut-and-dried answer applicable to all is impossible, for, within limits, each Museum requires to be adapted to the special characters of its locality, to the class of persons for whose instruction it exists, and to the special teaching of various subjects in the school curriculum.

Probably in all cases the objects possessed by any Museum can be arranged so as to bear reference to one of the following sciences: Ethnology, Zoology, Botany, Geology, and Mineralogy. It is almost superfluous nowadays to insist that each of these subjects should be kept distinct from one another. It is best that a separate room should be devoted to each, but since this must often be impossible in schools, at any rate let the cases contain specimens illustrative of one only of these "ologies," and let the object and purpose of each case be conspicuously apparent.

In any large school there are at least two sets of individuals whose needs must be considered in the arrangement of the Museum. Firstly, the average boy who has a healthy love of Nature, but does not know or wish to know overmuch about the details of structure, principles of classification, theoretical considerations, and so on, but is content with external form and interesting anecdotes. This variety of boy is destined to become a "country gentleman," and, as such, he has a sportsman's desire to be able to identify his captures and to know something of their habits. Such persons, be they young or old, deserve all encouragement; among their number are found a few ardent collectors willing to enrich the Museum and a few—alas! a very few—careful observers keeping an amateur naturalist's diary and

amassing a quantity of facts the record of which, though known for years by the student of the "literature of the subject," is of inestimable value in the training both of mind and eye. Secondly, the "scientific variety," *i.e.*, the boy who has deliberately chosen for himself a scientific profession and desires an elementary training in those subjects to which his after life is to be devoted. It is a lamentable fact that, in my experience, with one or two exceptions, the boy field-naturalist is not also the boy scientific. Granted, then, the existence of these two types, it is evident that what is necessary, helpful, and instructive to the latter, will not be palatable to the country gentleman in embryo; technical knowledge of any subject is to him "stinks," and as such not only is abhorrent to his nostrils, but may even disgust him to so great a degree as to make him fear contamination even in the open fields! Many a boy, aye and man too, is much interested in butterflies and moths, but has an extraordinary aversion to Lepidoptera.

It becomes, therefore, inevitable that a double arrangement of the Museum should be contrived, (1) a general natural history collection, by the aid of which boys may identify their victims; this should be arranged in such a way as to elucidate the main structure of the various groups in the animal and vegetable kingdom, and to stimulate collectors to cease to be merely such, and advance to the condition of accurate observers of the special group which they have made their hobby. This may be done by the introduction of exhibits illustrating the development and life-history of some common species, so that anyone with but little apparatus can verify each phenomenon for himself when once pointed out.

(2) A small collection of types as fully described, labelled, and explained as space will permit. In this series there should be no hesitation as to the use of technical terms, but let each term be fully explained and its derivation given, in order that the convenience and necessity of its use may be apparent. It is advisable that this series should conform to the course of class or special teaching adopted in the school, and it is undoubtedly desirable that it should, to a certain extent, follow the arrangement of some good practical text-book on the subject, so that a boy with book in hand can work through the entire series, or each section of it, prior to attempting the same section with scalpel and forceps in the laboratories.

We have not hitherto considered the needs of the general public in School Museums, nor should they be considered apart from the school with regard to arrangement. Nevertheless, it is a wise and generous regulation to admit visitors freely, nor will the concession be without return, for by this means the Museum is advertised, and residents of all classes will readily present specimens of great local interest, which ought to find their resting-place in some public institution and not remain hidden in private halls or on cottage mantel-shelves.

To pass on to the limits which should be assigned to the collections. Undoubtedly, in the Botanical and Zoological sections, especial prominence should be given to the local flora and fauna, but it is not advisable to limit the scope quite so narrowly, for boys come from all parts of the kingdom, and it is, for the most part, at their homes and during the holidays that most of their unaided work as naturalists is carried on. During term there are so many rival attractions, and such a love of athletic distinction, that many good naturalists forsake woods and meadows for the cricket field. It is therefore better, in these subjects, to extend the collections to all British animals and plants, and *to draw the line unflinchingly at this point*. If a Museum is to educate at all, the faculty of observation claims its attention before

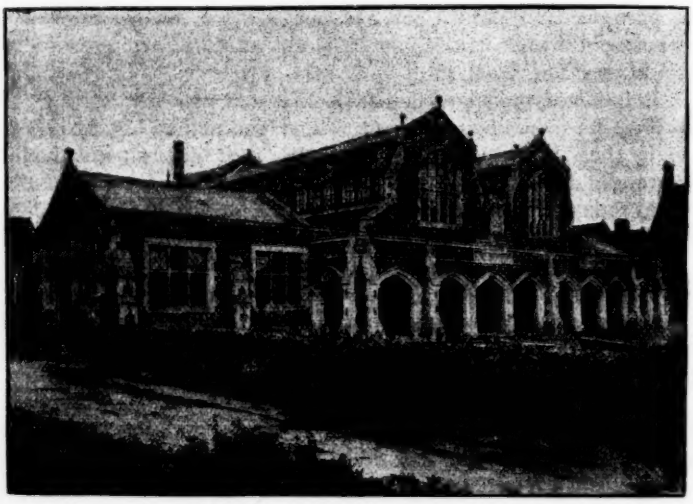

FIG. 1—EXTERNAL VIEW OF MUSEUM OF CHARTERHOUSE SCHOOL, GODALMING.
From a Photograph by [*Messrs. W. & A. H. Fry, Brighton.*

all others, and if the boy is not taught how and what to observe in the small world immediately around him, the man assuredly will not observe Nature truly in the enlarged world of after life. It is a difficult and often an ungracious task to say "no" to some generous offer of exotic lepidoptera, foreign birds, &c., to say nothing of heads of big game, stuffed crocodiles, and other "white elephants," but the refusal is absolutely necessary if any reasonably representative collection is to be set forth in the limited space at the disposal of any school. Let it, however, be at once stated that there is no objection to receiving foreign specimens of species which do occur in Britain, but let their locality be clearly stated on the labels, and also the fact that they are of British occurrence. Exception may, perhaps, be made in the series of special types where British species are inconveniently small; but

even so, foreign species should only be exhibited in company with their British congeners and should not entirely oust them.

With regard to the Geological and Mineralogical sections, the features of the immediate neighbourhood should be clearly displayed, but for teaching purposes it is best to follow pretty closely in arrangement some good text-book, of which a copy should be kept near the

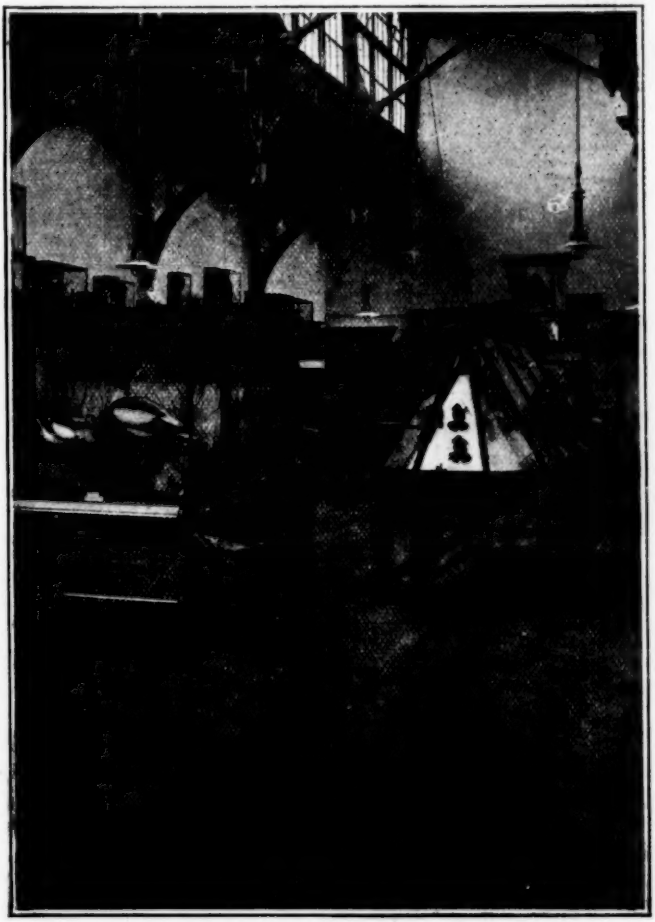

FIG. 2.—INTERIOR VIEW OF NATURAL HISTORY MUSEUM, CHARTERHOUSE SCHOOL.

cases or in the room specially set aside for these subjects. A series of well-described models of crystals ought to be placed in a conspicuous position in the collection of minerals, with actual examples, as far as possible, accompanying each model.

In addition to the actual exhibition rooms of a Museum, well-

lighted work-rooms ought to be within easy access, if possible under the same roof; one work-room, at least, should be for the use of pupils, and one should be for the private use of the Curator. The care of the Museum is most satisfactorily carried on by an official whose main work should be the arrangement, setting up, and labelling of specimens, while actual class teaching ought not to occupy any great portion of his time. Where this is impossible and one of the

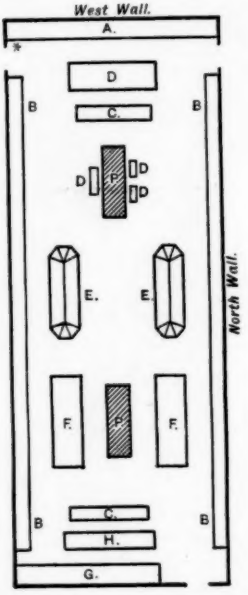

FIG. 3.—GROUND-PLAN OF NATURAL HISTORY MUSEUM, CHARTERHOUSE SCHOOL.

A.—Wall-case for Mammals.
B.B.B.B.—Side shelves for Birds.
C.C .—Central stands for ditto.
D.—Large entomological cabinet, surmounted by table case and double glass shelf.
D.D.D.—Small entomological cabinets.
E.E.—Show cases of types of Animal Kingdom.
F.F.—Table cases with Fossils.
G.—Wall case for Geological Model of Neighbourhood, etc.
H.—Botanical cabinet, surmounted by table case and double glass shelf, the two latter contain Mineralogical Collections.
P.—Stacks of hot-water pipes—tops are used for large fossils, etc.
* —point of view of photograph.

ordinary Masters of School becomes Curator, even though he be assisted by colleagues in various sections, it is most essential that there should be a thoroughly competent skilled assistant, capable of setting up specimens, making dissections, and conducting the general preparatory work. This particularly applies to the first few years after the opening of the Museum, for when once the permanent preparations are in position, the work of keeping all in good order is comparatively slight.

Turning now to the Museum at Charterhouse, the general features of the building can be seen from the accompanying figures. The

whole block consists of two centrally situated halls 75 feet by 27 feet 6 inches, running parallel to each other, these are flanked on the north and south by class rooms; to the west is a low colonnade, while the east end is formed by a large lecture hall capable of seating some 250 persons. The two central halls form the Museum proper; they are lighted by windows placed continuously on each side, immediately beneath the roof, and also by a pair of large windows in their western walls.

The south hall is devoted to Antiquities, Ethnology, Art, etc. In it are also contained many Carthusian relics, together with weapons of the chase, utensils, and so on of local interest, which furnish valuable mementoes of the simple country life of Surrey, a mode of life which is all too rapidly vanishing before the advance of railways and speculative builders. The two side walls are occupied chiefly by collections of flint weapons and of ancient pottery. The cases in which the latter is arranged are backed with continuous mirrors, so as to enable both sides of the specimens to be seen without opening the case fronts. Standing in the body of the hall are show-cases illustrating the various processes by which engravings, etchings, etc., are produced, or containing specimens obtained from the Swiss Lake Dwellings; others exhibit collections of ancient coins, Greek sculpture, and so on. In short, this portion of the Museum appeals to the anthropologist and antiquarian rather than to the student of Natural History in its ordinary acceptation.

To the north of this hall is the Museum of Natural History. The main portion of this is by force of circumstances devoted to birds. The accompanying ground plan will show at a glance the general arrangement. The whole length of the west wall is occupied by a large case with four glass doors which is to be devoted to mammals. Down both the north and south walls run two shelves at the height of about 3 ft. 6 ins. and 6 ft. 6 ins., on which are arranged the cases of birds. On the front of the lower shelf is a continuous glass-topped tray in which are placed the eggs, and where possible the nest of the species standing behind and above on the lower and upper shelf respectively. This collection of birds is of great local value; the major part of it was brought together during a period of many years by the late Mr. W. Stafford, of Godalming, by whom most of the specimens were both shot and set up. On the death of the collector a considerable sum of money was subscribed from various sources in order to prevent the collection from leaving the locality in which it had been made or being dispersed, and the whole collection, thus purchased, was handed over to the Charterhouse Museum. In addition to this, a notebook exists giving many details of the capture, locality, etc., of the specimens, and notices of other authenticated occurrences in the neighbourhood. It has thus been possible to affix to many of the cases the exact date and spot whence obtained. The wall space is insufficient to accommodate the whole collection, and

accordingly the geese and ducks are placed on brass-supported frames, running transversely to the length of the hall, near the west and east ends. The collection is strictly limited to British species according to the "Ibis" list, which has also been followed in the classification.

A few hybrids and professed "foreigners" have been removed from the collection and placed together in a separate part of the hall; eventually it is to be hoped they will be banished. The arrangement of the birds was necessarily the first thing to be attended to when the Museum was being equipped last year, thus many other sections of this half of the Museum are in a backward condition. Next to the birds, the insects, and especially Lepidoptera, attract most attention. Here the arrangements are good; there is a large entomological cabinet in which are being arranged all the British Macro-lepidoptera. It is intended that the full life-history of every species shall be shown with larvæ on artificial food-plants, pupæ both in and out of cocoon where such exists, and imagines in resting attitudes, as well as the conventional "setting." This, of course, will be a work of years; but it has begun and is progressing. Above the cabinet is a table-case, in which will be placed diagrams and described specimens to show the chief anatomical features of the various orders of insects; and above this again double glass shelves for miscellaneous objects of interest connected with the habits and economy of insects. In addition, there has been presented a fine collection of Lepidoptera (imagines only), which is kept apart. Hymenoptera have claimed a few votaries, but other orders of insects fail to attract at present. There is accommodation for a collection of Mollusca and material, chiefly foreign, where much weeding will be necessary.

Two show-cases standing in the room are devoted to special types, one including Protozoa to Mollusca, the other Chordata. These are intended for specialists in Biology, and will ultimately be arranged so as to follow, with a few additions of extinct forms, the book of Practical Zoology in use in the school. There are two table cases of fossils arranged stratigraphically. A case of Minerals arranged after an elementary text-book stands near the east end of the room, and beneath this case a collection of dried plants mounted on cards and placed on sliding trays. Portfolios of dried plants, comprising collections made in the neighbourhood of Godalming, complete the Botanical section at present. At the east end of the hall is a large wall case, destined to contain a Geological model of the neighbourhood and diagrams to illustrate sections. The fossils characteristic of the strata, and, as far as possible, the peculiarities of fauna and flora, will be pointed out. Beneath the shelves on which the birds are placed is a vacant space which eventually can be occupied by low cabinets, storecases for duplicates and specimens, for class work.

The care of the Museum is entrusted to two of the Masters of

the school, who are unfortunately not assisted by a regularly trained skilled assistant. It may seem ungracious to criticise what is in many respects excellent, but a few possible improvements may be mentioned for the warning and benefit of others who have not yet "builded new barns" for Museum purposes. (1) There are no work-rooms in connection with the Museum, nor any rooms situated conveniently near in which the work of preparation can be carried on. The inconvenience of this want to the Curators will be only too obvious to all who have ever had charge of any portion of a Museum. Moreover, the absence of a work-room for students greatly limits the usefulness of the collections. (2) The position of the windows, though giving a good light, does not give so good a light as continuous skylights would have afforded. (3) The supports of the roof descending on to the main walls of halls curtails the available wall-space to a great extent. In the present instance, had the roof been supported in some other way, a rail-gallery would have been possible round both halls, which would have doubled the wall-space. Under the present circumstances, nearly half the wall-space is too high for *instructive* exhibition purposes, though it can be made serviceable for the reception of various gifts which have no proper place in a School Museum, and can therefore without loss be "skied" into positions sufficiently remote as not to disturb the visible arrangements, and sufficiently prominent to gratify the well-meaning donors.

OSWALD H. LATTER.

VI.

The Surface of the Moon.[1]

IN the January number of NATURAL SCIENCE, attention was directed to two short articles on the subject of lunar volcanoes and lunar glaciation. In the *Bulletin of the Philosophical Society of Washington* (vol. xii., April, 1893, pp. 241–292) will be found a paper on "The Moon's Face, a Study of the Origin of its Features," being the retiring address of the President, Professor G. K. Gilbert. This is an admirable summary of the history of the study of the moon's surface, while, at the same time, it abounds with suggestive and thoughtful ideas. Professor Gilbert commences by remarking that the topography of the moon is perhaps better mapped than that of North America, and mentions the various features which have been observed and named. The "craters" are described, and figures are given, comparisons being drawn between the "wreath" of a lunar "crater" and the landslip terraces of the margin of a basaltic plateau. After this descriptive matter, the various "theories" are taken into consideration. Regarding the "volcanic theory," Professor Gilbert compares unfavourably the relative abundance of the craters on the moon with any equal area on the surface of the earth, those on the earth being as one-tenth to those on the moon. The same disparity exists with respect to size, the ten largest terrestrial craters recorded having a mean diameter of eleven miles. These are, Lake Bourbon (Luzon), 16 by 14 miles; Asosan, 15 miles; Kamschatka (Scrope, 2nd ed., p. 457), 15 miles; Mauritius (Darwin), 15 by 11 miles; Lake Bolerna (Italy), 11 by 9 miles; Lake Maninju (Sumatra), 15 by 7 miles; Pepandayan, 15 by 6 miles; Teneriffe, 7 by 8–10 miles; Deception Island, 8 by 7 miles; Monte Cavo, 7 miles; Mount Marindin (Mindanao), 9 miles; Mount Astria (Iceland) 10 miles. The mean diameter for the ten largest lunar craters visible to us is 275 miles. These are, Apennines, Serenitatis, Crisium, Humorum, Humboldtianum, Bailly, Iridium, Clavius, Otto Struve, and Grimaldi. The actual largest terrestrial crater has a diameter of about fifteen miles, the largest lunar crater, that whose rim is partially preserved in the Carpathian-Apennine-Caucasus chain, has a

[1] Précis of Professor G. K. Gilbert's address to the Philosophical Society of Washington, December 10, 1892. By C. Davies Sherborn, F.G.S.

diameter of 800 miles. There is no important discrepancy in the vertical dimensions. Lunar craters of the first rank range from 8,000 to 15,000 feet in depth; terrestrial craters, probably from 2,000 to 4,000 feet. The contrasts as to form are of greater importance, and are all fully set forth in the paper. Professor Gilbert concludes by observing that "the volcanic theory, as a whole, is therefore rejected, but a limited use may be found for the maar phase of volcanic action [no eruption of lava, but merely an explosion of steam] in case no other theory proves broad enough for all the phenomena."

Passing next to the tidal theory, Professor Gilbert puts aside the views of Rozet, Hooke, Bergeson, and Humphreys, and considers those of Faye, Ebert, and Hannay. These postulate a time when the moon was liquid, with the exception of a thin crust. The moon then rotated more rapidly than now, and great tides, excited by the earth's attraction, racked and cracked its crust, and here and there squeezed out a portion of the liquid nucleus, which flowed back again when the tidal wave had passed; but congelation caught the flood at its edges, so as to mark its limit by a solid ridge. By each successive tide the operation was repeated, with the result that the wall was given a circular form, and was gradually built up. The process was finally closed by the congelation of lava in the orifice, and while congelation was in progress the last feeble eruption sometimes produced a central hill. Professor Gilbert asks, in criticising this theory, for an explanation of the multitude of small craters overlying the larger, and why, if the crust were divided by fissures, would not the tensile strains wrought by the crest of the tidal wave cause the fissures to gape, instead of forcing out the liquid through apertures here and there? Or, if there were no fissures, would not the strains suffice to produce them? He further points out that there are numerous craters, of small or medium size, occupying slopes of the greater crater rims, and the initiation of these by tidal process seems impossible. Whatever lava escaped from an orifice on a slope would, he remarks, flow down the slope, instead of being drawn back.

The views of Ericsson and Peal, that the site of each crater was once occupied by a pool of water which, by heat from below, was vapourised, converted into snow, and from which was eventually accumulated an annular ridge, he criticises as follows:—If the rim were built up by the quiet fall of an infinitude of ice particles or snow flakes, its configuration should be smooth and regular instead of exhibiting the rugosity actually observed. The postulated heat of the central area might render the inner slope steep, and even produce the inner cliff and terraces, but the theory affords no explanation of the wreath nor of the central hill; it fails also to account for the small craters formed on the rims and slopes of the larger, for the bottoms of these are far above the assumed rock plain of the moon, through which the theory supposes the internal heat to have been communicated. Professor Gilbert admits that he is unable fully to

judge Peal's views, which have been circulated in a pamphlet, of which 100 copies were privately printed, and therefore practically unpublished and inaccessible.

All other theories which have been put forward appeal in some way or other to the collision of other bodies with the moon's surface, and Professor Gilbert groups them together under the heading "Meteoric." Proctor apparently was the first to definitely suggest a "meteoric" theory in 1873 and 1878. "Asterios" and Meydenbauer have also advanced similar views. The "meteoric" theory is thus defined in Gilbert's paper:—If a pebble be dropped into a pool of pasty mud, if a rain-drop falls upon the slimy surface of a sea marsh when the tide is low, or if any projectile be made to strike any plastic body with suitable velocity, the scar produced by the impact has the form of a crater. This crater has a raised rim, suggestive of the wreath of the lunar craters. With proper adjustment of material, size of projectile, and velocity of impact, such a crater scar may be made to have a central hill, and it is Professor Gilbert's belief that all features of the typical lunar crater and of its varieties may be explained as the result of impact. His arguments may be summed up in the following sketch. The shooting star records by its brief coruscation the collision with our atmosphere of a particle of star dust; and although they are generally very minute in size, a few survive after passing through an atmosphere and reach the earth as aerolites weighing ounces, pounds, or occasionally tons. It is also an ascertained fact that these bodies are spreading in countless myriads through space in all directions. As the moon is either without atmosphere, or has one of extreme tenuity, the impact of one of these bodies may have an important effect on the surface. As it is incredible that even the largest meteors of which we have direct knowledge should produce scars comparable in magnitude with even the smallest of the visible lunar craters, advocates of meteoric theories have assumed that at some earlier period the meteors encountered by our solar system were of greater size than now, and as no evidence has been found that the earth was subjected to a similar attack, there is assigned to the lunar bombardment an epoch more remote than are the periods of geological history, any similar scars produced on the earth having been obliterated.

Professor Gilbert does not assume that the surface of the moon was necessarily soft. Rigidity and plasticity are not absolute terms, but relative. But he suggests that the heat developed by the sudden arrest of a fragment of matter travelling at the rate of 45 miles per second might serve not only to melt the fragment itself, but also to liquefy a considerable tract of the rock mass by which its motion was arrested. The difficulty of the relation of the volume of the rim to the capacity of the hole is carefully considered, and experiment proved that when target and projectile were of uniform consistency throughout, there was no defect of rim; but when the general mass

of the target was softer than the portion at the surface, the uplift consequent on the production of the hollow was only partially localised about its periphery, the remaining part being widely distributed through the floor of the softer material below. The last difficulty is connected with the circular contours of the craters. The predominant direction of the swiftly moving meteoric bodies approaching from all directions would be about 45°, and the scars produced by collision would be predominantly oval instead of predominantly circular. Proctor suggested that immediately after the shock of the collision there might be an elastic return to a circular form ("The Moon," London, 1873, p. 346); but to account for this peculiarity of form of the lunar craters, Gilbert advances a "Moonlet Theory," assuming that before our moon came into existence the earth was surrounded by a ring of meteors similar to that possessed by Saturn, and that the small bodies constituting this ring afterward gradually coalesced, gathering first around a large number of nuclei, and finally all uniting in a single sphere, the moon. Under this hypothesis the lunar craters are the scars produced by the collision of these minor aggregations or moonlets, which last surrendered their individuality. This theory is fully explained and worked out in the address, to which the reader must be referred for details.

Professor Gilbert then discusses the "arched floors" of some of the larger craters, and the distribution and overlap and interference of the craters themselves; and then turns to the question of lunar sculpture. The sculpturing of the Mare Imbrium has particularly engaged his attention, and he points out that the trend of the sculpture lines and a peculiar softening of the minute surface configuration, as though a layer of semi-liquid matter had been overspread (which he believes to be the fact, the deposit having obliterated the smaller craters and partially filled some of the larger), indicate that a collision of exceptional importance occurred in the area of the Mare Imbrium, and that one of the results was the violent dispersion in all directions of a deluge of material—solid, pasty, and liquid. The effect of this "splash" has been traced by Gilbert 900–1,000 miles in one direction, and he estimates the volume of the projectile to have equalled a sphere 80–100 miles in diameter. A sketch-map is given, showing the trend of the lines of sculpture, and the broken and notched rim of the Mare Imbrium.

Referring to the "furrows" seen on the moon's surface, so remarkably straight in general, one of which is calculated to be 187 miles long, 10–25 miles wide, and 11,000 feet deep, it is suggested that these are the tracks left by solid moonlets, whose orbits at the instant of collision were nearly tangent to the surface of the moon. It is curious that when plotted on the chart of the moon's face, Professor Gilbert found that more than half of them accorded in direction with the trend lines of the Imbrium outrush, and he is led to suggest a connection between them and the scattered fragments dispersed by

the collision in that district. The anomalous plateau of Wargentin is considered, but no definite suggestion is made, although clues are not wanting, for the whole neighbourhood abounds in evidence of flooding.

With regard to the "white streaks," which are quite independent of any surface configuration, and which usually radiate from some crater itself lined with a similar white matter, Professor Gilbert quotes an unpublished suggestion of William Würdemann of Washington, which is as ingenious as it is simple. Würdemann writes to Dr. B. A. Gould as follows:—"The most remarkable appearance on the moon, for which nothing on earth furnishes an example, is presented by those immense radiations from a few of the larger craters—perfectly straight lines, as though marked with chalk along a ruler—starting from the centre of the crater and extending to great distances over every obstruction. My explanation is that a meteorite, striking the moon with great force, spattered some whitish matter in various directions. Since gravitation is much feebler on the moon than with us, and atmospheric obstruction of consequence does not exist, the great distance to which the matter flew is easily accounted for." Gilbert remarks that this theory accounts for the straightness of the rays, for their vanishing edges and ends, for their independence of topography, for their relation to craters, for the whiteness of the associated craters, and for the nimbus in which the rays sometimes unite close to the crater. It further explains the white crests of many grey craters, for peaks would intercept more than their share of the horizontal shower. The difficulties and suggestions of this theory are fully dealt with by Professor Gilbert, and he is inclined to believe the white matter to be a readily fusible solid.

Summing up the various theories in his retrospect, Professor Gilbert says:—the impact theory applies a single process to the formation of craters (excepting only the rill pits), correlating size variation with form variation in a rational way. Specialised by the assumption of an antecedent ring of moonlets, it accounts also for the great size of many craters. It brings to light the history of a great cataclysm, whose results include the remodelling of vast areas, the flooding of crater cups, the formation of irregular "maria," and the conversion of mere cracks to rills with flat bottoms. It explains the straight valleys and the white streaks. In fine, it unites and organises as a rational and coherent whole the varied and strange appearances whose assemblage on our neighbour's face cannot have been fortuitous.

The address concludes with a brief discussion of the growth and age of the moon. Professor Gilbert believes that during the whole period of growth the surface lost heat by radiation, but the process of growth cannot have been slow enough to permit the concurrent dissipation of all the impact heat. Liquefaction was a local and temporary surface phenomenon, and there is little evidence of the wrinkling, which, theoretically, should result from the adjust-

ment of a cold crust to a cooling nucleus. The topography is due to sculpture, not to wrinkling; the smooth floors of the maria have anticlinal and monoclinal forms, but of so gentle a slope that they are seen very near the terminator, and can represent but a minute amount of arc shortening. It is therefore probable that the final shrinkage of nucleus was small, and the antecedent storage of heat correspondingly small. During the whole period of growth, the body of the moon was cold. With regard to the age of the moon, Professor Gilbert asks two questions. (1.) Does the earth exhibit impact craters? If not, then erosion and sedimentation have destroyed them, and the Cenozoic era did not witness the building of the moon. (2.) Is any horizon of stratified rocks generally or widely characterised by molten disjecta? If not, then the moon was already a finished planet in Palæozoic times.

VII.

Antarctica: a Supposed Former Southern Continent.

IN the current number of the *Geographical Journal* there appears a paper by Mr. H. O. Forbes, on "The Chatham Islands: their relation to a former Southern Continent," read before the Royal Geographical Society on the 13th March last. He describes his discovery there in the previous year of remains of a large extinct ocydromine Rail, which he has identified with *Aphanapteryx*, a genus till then known only from Mauritius, and of a large *Fulica* closely related to *F. newtoni* of the same region. Taking these fresh facts into consideration, he marshals all the data which he considers prove a strong case for the probability of the existence of a former southern continent, and he sketches on a map of the Southern Hemisphere what he believes was the configuration of *Antarctica*, as he has named that vanished continent. He believes that it followed nearly what is the 2,000-fathom line, and extended northward from a circumpolar area, by broad extensions, one to join an old New Zealand continental island (including the Antipodes, the Maquarries, New Zealand, the Chatham, Lord Howe, Norfolk, the Kermadec, and the Fiji Islands); another to East Australia with Tasmania; another to the Mascarene and surrounding islands (the *Lemuria* of Sclater); *perhaps* one to South Africa, and, lastly, one to South America. The form of this continent would not interfere with the opinions expressed by many authorities in the permanence of the great ocean basins.

The chief evidence adduced by Mr. Forbes in support of the former existence of this continent, shortly stated, rests on the distribution of forms confined to or extending but little beyond the Southern Hemisphere.

I.—Among Aves.

1. Of the Struthious birds:—*Dinornis* and *Apteryx*, in New Zealand; *Dromornis* and *Dromæus* in Australia; *Casuarius* in the Papuan sub-region; *Æpyornis* in Madagascar; *Brontornis* in Patagonia.
2. Of the Trogonidæ in South America, Tropical and South Africa, and in the Indian region.

3. Of the Spheniscidæ, which are confined to the Southern Hemisphere, and appear fossil in New Zealand and in Patagonia.
4. Of the Chionidæ, a family of the Charadriidæ, confined to the Antarctic Islands.
5. Of the Psittacomorphæ, confined chiefly to the Southern Hemisphere, with a few stragglers in North America and a few groups in India.
6. Of the *Peristeropodes* (of the Gallinaceæ) in Australia and in South America.
7. Of the Ocydromine Rallidæ (*Aphanapteryx*), of *Fulica* and *Notornis*, of *Frigelupus* and *Heterolocha*, in the New Zealand and the Mascarene regions.
8. Of Solitaire, Dodo, and Didunculus, in the Mascarene Islands and Samoa.
9. Of the Avocets and the Stilts, in New Zealand, Australia, Africa, and South America.
10. Of the embryological affinities of the Dendrocolaptine birds of the Neotropical region with the Gymnorhine crows of Australia; of *Artamus*, with *Pitta* and *Grallaria*; of *Petræca*, with the Mniotiltidæ; of the New Zealand Xenicidæ, with the Australian and Oriental Pittidæ, the Mascarene Philepittidæ, and the Neotropical Pipridæ, Cotingidæ, Tyrannidæ—evidence of great weight.

II.—Among other Vertebrata.

1. Of Marsupialia—*Nototherium*, *Diprotodon*, *Thylacoleo*, *Thylacinus* in Australia; *Prothylacinus*, *Amphiproviverra* in Patagonia.
2. Of Edentata—In South America, South Africa (Orycteropidæ) and in India and the Malay Archipelago (Manidæ).

   This distribution of the *Edentata* may, however, indicate a connection of "Antarctica" with Africa and South America when it was not in connection with Australasia, but when there was a bridge between East Africa and the Oriental Region.
3. Of Amphibia—Cystognathidæ in Australia, Tasmania, and South America; and giant tortoises in Madagascar and the Galapagos Islands.
4. Of Fresh-water Fishes—the great alliance between those of Australia, New Zealand, Chili, Patagonia, and the Falkland Islands; Haplochitonidæ and Galaxiidæ and the Dipnoan and Osteoglossid types in South Africa and in South America.

III.—Among Invertebrata.

1. Of *Peripatus* in South Africa, Australia, South America, with the West Indies.

2. Of *Cercophonius* (a genus of Scorpions) in South East Australia and South America.
3. Of Buprestidæ and *Longicornia* in South America, Australia, and New Zealand.

IV.—Among Plants.

1. Saxafrageæ—Escalonieæ (17 genera) and Cunonieæ (18 genera) in New Caledonia, Australia, Tasmania, New Zealand, Mascarene Islands, South Africa, South America. Only two of these 35 genera cross the Equator.
2. Proteaceæ (49 genera, 950 species)
3. Monimiaceæ (22 genera and 250 species)

   } in South America, South Africa, Madagascar, Tasmania, New Zealand, New Caledonia.

4. Of the Cupressinæ (Coniferæ), *Callitris* in Africa, Madagascar, Australia; *Fitzroya* in Chili and Tasmania.
5. Of the Verbenaceæ, *Petræa* typically South American, in Java and Timor, and *Petræovitex* nearly related to *Petræa* in Buru and Amboina.
6. Of *Senecio appendiculatus*; *Fernelia buxifolia*; *Chasalia capitata*; *Pouzolzia lævigata*, *Cyperus scoparius* in Timor and in the Mascarene Islands.
7. Of *Ranunculus trullifolius*, *R. Mosleyi* (allied), *Lyallia*, in Kerguelen and in Fuegia.
8. Of *Polypodium vulgare* in Kerguelen, South Africa, South America, and Marion Islands. *Cotula plumosa*, *Uncinia compacta* in Kerguelen and Australasian region. *Pringlea* in Kerguelen and Marion Islands.
9. From the remains of buried forests, and the occurrence of lignite beds, and of enormous deposits of Peat in the Chatham Islands, in Kerguelen and in other Antarctic Islands, indicating a former forest-clad region.

The development of the Southern fauna and flora occurred, Mr. Forbes believes, during the Ice Age of the Northern Hemisphere when "Antarctica" rejoiced in a semi-tropical climate. Their dispersion occurred during the slow oncome of the partial glaciation of the Southern Hemisphere, which exists now.

The occurrence of many southern forms of life in the Miocene of France and other parts of Europe is explained, according to the author, by their having been driven north during a cold, or perhaps glacial, period in the Southern Hemisphere in that age, of which there are evidences in various parts of South Africa, Australia, and South America, corresponding to the warm epoch in the Miocene age in northern latitudes.

Mr. Forbes has independently arrived at views very similar to those expressed by Professor L. Rütimeyer in 1867 in his work, "Ueber die Herkunft unserer Thierwelt: eine zoogeographische Skizze"; and several geologists, notably Dr. W. T. Blanford, have discussed some of the more important problems involved. We have, however, compiled a concise synopsis of Mr. Forbes' latest arguments in favour of the theory of "Antarctica" (based upon the known distribution of certain animals and plants), because the sum-total of the evidence is now so much greater than it has been heretofore; and such marked progress has been made in investigating the geology of the Southern Hemisphere during recent years, that it seems profitable to re-open the question from the geologist's point of view once more. Zoologists and botanists will welcome the expression of the latest views of those who are acquainted with the physical considerations bearing upon the subject.

VIII.

On the Work of Glaciers.[1]

AN invitation from the Editor of NATURAL SCIENCE to write a short critical review of Professor Bonney's article on Glaciers in the current number of the *Geographical Journal*, is as refreshing as a whiff of cool, pure air from the "Gletcherwelt" in these sultry June days. To be brief in the present instance is not difficult, since I have nothing of importance to add to what I have already put into print, while I have nothing, on the other hand, to unsay. One has not time in these days to go on repeating, *ad nauseam*, the same arguments. All that my friend Dr. Blanford has urged now has been met and answered, as I venture to think, by anticipation in my papers, and in the criticisms which I have published of the writings of others during the last ten years, that is to say, since my papers (1) "On the Mechanics of Glaciers," (2) "On the Origin of Valley Lakes," were published side by side in the February number of the *Quarterly Journal of the Geological Society* in 1883. On the other hand, after reading the article of Professor Bonney's, which I have been asked to notice, I can only find one criticism to offer, and that is that he does not make enough of the physical impossibility of the work of excavation being done by ice, or of local earth movements, which must occur as details of the "warping" of the crust, in districts such as must be subjected to considerable squeezing between two great stable masses of the Archæan crust, as these undergo circumferential approximation towards one another by secular contraction. All that has been written in more recent years by Professor Spencer (and others) on the negative results observed by him under some of the great Norwegian glaciers, and the positive results obtained by himself and his colleagues as to the recent changes of level in the region of the great lakes of North America, co-operating with the damming-up of old Eocene lines of drainage by glacial detritus during the Quaternary period, goes to confirm the suggestion (*inter alia*) that I threw out ten years

[1] "Do Glaciers Excavate?" By Professor T. G. Bonney, D.Sc., F.R.S. With observations by Dr. W. T. Blanford, Mr. Douglas Freshfield, Sir Henry H. Howorth, and Mr. W. M. Conway. *Geographical Journal*, vol. i., pp. 481–504 (June, 1893).

ago as to the origination of the basin of the Lake of Geneva by the pinching up of the valley of the Rhone, as an incident in the comparatively recent movements that have given to the Alps and the Jura their present positions.

There are some pertinent remarks to the same effect in Heim's well-known "Mechanismus der Gebirgsbildung"; and that writer once for all disposes of the case of the Vierwaldstättersee (Lucerne Lake) by the results obtained by a series of soundings carried out by himself and one of the engineers of the Federal Government; since these show conclusively that the bed of the lake is *an alluvial plain* of an ancient valley, which has been converted into the present gem of central Alpine lakes by a partial closure of the valley at the outflow of the Limmat. The deep Achensee, again, is completely explained by the facts which I gave ten years ago, as a case of a fault-originated gorge, the drainage having been reversed as the great gorge of Jenbach was dammed by the moraine stuff from a side-valley at Maurach.[2] The Lake of Constance, again, is now well known to be a hollow formed by the damming-up of an ancient valley by glacial detritus; the present "Falls of the Rhine" at Schaffhausen having originated from a similar set of surface-changes to those which have produced the Falls of Niagara, by diversion of drainage due to glacial obstruction of the ancient valleys. Instance after instance of those quoted by Ramsay and his school (even Ramsay's pet child, the Lake of Llanberis) is being disposed of, as larger views of physiography are made to bear upon the study of lakes.

To go in detail into Dr. Blanford's criticisms would be but to attempt to combat a *scientific belief*, which has been, to my mind, rendered untenable by counter-arguments, based on known physical and mechanical laws and observed facts. Until "geologists" will take the trouble to go into the physical laboratory and master those laws, and then show that my experimental work of ten years ago in the Wellington College Laboratory upon the properties of ice, and the conclusions to which it leads, as put forth in my paper on the "Mechanics of Glaciers" (*supra cit.*); in the paper supplementary thereto on "Solar Radiation and Glacier Motion";[3] in some criticisms of a paper by another author which I published under the title of the "Motion of Land Ice";[4] and in the remarks which I made two years ago under the head of "Dr. Nansen on Glaciation,"[5] I feel that it is rather a "dealing of blows into the air" to enter into controversy on these points.

The phenomena of the recession of glaciers within the last century or two, leaving a plain strewn with rolled detritus, and the draining

[2] See my paper on the "Triassic Deposits of the Alps," *Geol. Mag.*, 1882, p. 504.

[3] *Nature*, vol. xxvii., 1883.

[4] *Geol. Mag.* for 1891, pp. 141–142.

[5] *Nature*, vol. xliii., pp. 541–542.

of a still more ancient lake by the sawing through of a moraine-dam by the valley-stream, can scarcely be better illustrated than in the case of the Rosegg-glacier. There, as in many another Alpine example, the recession of the glacier leaves no trace of excavation of the valley floor, but the contrary. The Muir Glacier of Alaska is also a very strong case. I gratefully avail myself of the paper on this which Professor Cushing, of Cleveland, Ohio, was good enough to send me.[6] His concluding remarks are—"Those who hold the power of glaciers to vigorously erode hard rocks under most circumstances, take (it seems to me) an indefensible position. At the Muir Glacier, in just the position where the greatest erosion would naturally be expected, soft gravels have been undisturbed by the ice. The key setting forth when glaciers will erode and when not, is certainly lacking at present. It is very desirable that a prolonged and detailed study of the Muir Glacier should be undertaken. It is a comparatively large glacier, rapidly dying out, and presents an admirable opportunity for studying the behaviour of a large glacier under such circumstances. Such work could not fail to be of great value."

On one minor point I cannot follow Professor Bonney. When referring to Ramsay's classical paper, he says (p. 482): "It was proved that the rock-basins of the Alpine lakes could not have been produced by any local subsidence, or by fissures in the Earth's Crust." In reasons given in my paper (*supra cit.*) on the "Origin of Valley Lakes," I have given the grounds of this dissent. I believe that, in certain instances, these have severally operated as *important factors*, though not as sole cause, and my belief of ten years ago has been confirmed by the observations I made in 1883, through the courtesy of F. Ritter von Hauer, of models of saliferous and gypsiferous strata, beneath upland valleys in the Alpine Trias, which are to be seen in the Geologische Reichsanstalt of Vienna. Mr. Jukes Browne has referred to these in his "Handbook of Physical Geology" (2nd edition, p. 627). Let underground erosion by the solution and removal of such beds or of calcareous strata proceed through a long period of time, and another great glacier filling such a valley would make, by its dead weight, short work of the hollow floor. Such a crushing-in of the pie-crust is, however, a very different thing from what Ruskin has graphically described as a "custard scooping out its own dish." I suggested this ten years ago: its *rationale* is self-evident, but it has I suppose been ignored by subsequent writers because it was not "orthodox," though it commended itself to the late Professor John Morris, when I suggested it to him. But subsidences can and do occur without the crushing weight of glaciers.

The old and trite argument based on the association of lakes with glaciated regions may be put another way. It may, I think, be fairly asked, whether it is not the association of lake-basins in great numbers

[6] *American Geologist*, October, 1891.

(as in Scandinavia, Finland, and North America) with great districts, in which the terrain is for the most part made up of Archæan crystalline rocks, in which therefore the traces of glaciation in high latitudes are better preserved, and surface changes (including differential movements) have been longest in progress, that has led to some confusion of thought on this matter.

A. IRVING.

IX.

Professor Huxley on Evolution and Ethics.[1]

PROFESSOR HUXLEY'S zoological work is great, and it has left an enduring mark on his science. He has lived in times when a new idea has been a solvent corroding the incrustations of tradition and habit, and those who knew the jewel of truth only by its setting and tarnished ornament, hated and feared him. Acute minds, orthodox or unorthodox, respected and admired him as a master in the craft of controversy, honest and resolute, apt at keen lunge and nimble recovery. But the great crowd who make reputations that iconoclastic historians of the future may have material, see in him a constructive thinker—a prophet of the new era. And so this delivery on "Evolution and Ethics" will be taken as coming "with emphatic warrant," and must be subjected to a more critical appreciation than the author himself may think fitting.

Let me state the Professor's argument as clearly as I can. Among the observed phenomena of the cosmos the most typical is cyclical change. Thus, from the inert bean there grows up the bean-plant, which, in its turn, produces other beans, and the wonder of leaves and stem fades away. Such recurring cycles are the salient feature in the shifting impermanence of the cosmos. In man, to whom the stream of life has apparently led, we find that pain, present everywhere, reaches its acutest point, and we find that his progress has been such that the old ape and tiger habits of ruthless and cruel aggression are only virtues belated in time, and become sins by the accident of advance. Thus consideration of the cosmic process of evolution brings man up against the mystery of evil.

With the philosophers of Hindustan and Ionia, centuries before our era, the changefulness of the phenomenal world, as well as the suffering in it, became apparent. When culture of the intellect and of the pleasures followed material prosperity, there came exhaustion and ennui and that "beneficent demon, doubt, whose name is legion and who dwells amongst the tombs of old faiths." Originally the conception Justice arose from some beginning like the compact of a wolf-pack, the understanding not to attack one another while on the chase. From this

[1] EVOLUTION AND ETHICS. By Thomas H. Huxley, F.R.S. The Romanes Lecture for 1893. London: Macmillan & Co., 1893. 57 pp. Price 2s. net.

came the conception of justice-in-itself, of merit as divorced from the effect of action on others, the abstract idea of goodness.

The old world philosophers, turning from this new conception to the cosmos, found the cosmos incompatible with goodness. Suffering and sorrow, sunshine and rain, were distributed independently of merit. With Greek and Semite and Indian the conscience of man revolted against the moral indifference of nature. Instead of bringing in a verdict of guilty, they attempted reconciliation in various ways. Indian speculation invented or elaborated the theory of transmigration, in which the Karma or soul-character passed from individual to individual, and in the whole chain the algebraic sums of happiness and sorrow were proportional to desert. Attempts at metaphysic were more potent in shaping ethics. Then, as now, a permanent "substance" was supposed to underlie the shifting series of phenomena of mind and matter. The Indians called the "substance" of the cosmos "Brahma," of the individual "Atman." The "Atman" had its individual existence only through its casing of phenomenal desires and passions, and the aim of wise living was not merely to destroy the body, but, by a rigorous and disciplined asceticism, to suppress all individual desires, until "Atman" in negation of self became merged in "Brahma."

Gantama accepted most of these premises, but going beyond them, he disbelieved in the substance of mind as of matter, and reduced all to a shifting series of phenomena.

Karma was handed on by a process of induction from phenomenon to phenomenon; transmigration was abolished and Nirvana, the cessation of all became the ultimate good. But the means for this was not asceticism, but culture of moral qualities, and a direct attack on the baser passions as desires.

The Stoics also were metaphysicians, and imagined an immanent, omnipotent, and infinitely beneficent cause. Evil was incompatible with this, and so they held against experience that either it did not exist, or it was inflicted for our benefit or due to our fault. These theories, although they remain on evidence, do not explain "why the immense multitude of irresponsible sentient beings, which cannot profit by such discipline, should suffer." The practical conclusion of the Stoics was to live according to nature; not nature in the sense of the crude individualism of later days, but the higher nature of moral man as opposed to the lower nature of the world in general. The ethical system of the Stoics was divorced from this theory of the cosmos; it was purely intuitional, and they came to see that the ideal wise man was incompatible with the nature of things; that the cosmos works through the lower nature of man not for righteousness, but against it. So their "perfect way" came to be "apatheia," in which desire must do nothing but execute the judgment of pure reason.

Thus Professor Huxley sees the same course in the evolution of

ethics among Indians and Greeks; and the end, when the "malady of thought" brings the conception of good against the evil of the cosmic process, is Nirvana or Apatheia—salvation sought in absolute renunciation.

In the modern world, the scientific optimism of a few years ago is falling before a frank pessimism. Cosmic evolution is accountable for both good and evil, but knowledge of it provides no better reason than earlier speculation for choosing the good. The survival of the fittest does not mean the survival of the best, but of the best adapted to the conditions. The cosmic process is not only non-moral, but immoral; goodness does not lead to success in it, and laws and moral precepts are directed to the curbing of it. Still, Professor Huxley sees a way out of absolute pessimism. Society remains subject to the cosmic process, but the less as civilisation advances and ethical man can combat it. The history of civilisation shows that we have some hope of this, for when physiology, psychology, ethics, and political science, now befogged by crude anticipations and futile analogies, have emerged from their childhood, they may work as much change on human affairs as the earlier-ripened physical sciences wrought on material progress. And so, remembering that the evil cosmic nature in us has the foothold of millions of years, and never hoping to abandon sorrow and pain, we may yet, in the manhood of our race, accept our destiny, and, with clear and steady eyes, address ourselves to the task of living, that we and others may live better.

It would be absurd to imagine that Professor Huxley considered this eloquent address a reasoned exposition, and indeed many of his own notes supply precisely those remarks which a hostile critic would have been glad to make. The sole occasion of criticism is that the address will have a positive scientific value assigned it. The dominant note in the address is that the process of life presents the "appearance of cyclical evolution." The "value of a strong intellectual grasp of the nature of this process lies in the circumstance that what is true of the bean is true of living things in general." This is really an argument from analogy, and has no value in a constructive system. The politician addressing those who agree with him, or the preacher strengthening his hearers in the faith which they share with him, use analogies with right and reason. But they are essentially rhetorical appeals. They become arguments only when by reason of some definite identity in the subjects compared they cease to be analogies. The Professor in his first note (on the word "appearance" in the sentence just quoted) shows that he introduces the example of the bean-plant as a mere analogy. The actual process true of all living things is not a cyclical but a linear evolution. A continuous chain stretches from every living being to the distant and prodigious first appearance of life. The successive individuals are pendants of the chain, and, dropping off, leave it unbroken.

Professor Huxley makes too much of the shifting impermanence

of all things, both on his own account and in his interpretation of the old world philosophers. In the physical world impermanence means no more than constant movement; that energy rather than inert matter is the conspicuous phenomenon. In the mental world, it is true "that no man can, with exactness, affirm of anything in the sensible world that it is." But that is an ultimate metaphysical difficulty in a manner distinctive of all thinking, in a manner distinctive of none. The human mind is conditioned by its own limitations, but these limitations are conditions to be held in the background of all argument, an understood preamble in all thinking, and by no means to form an "in-and-out clause" in questions at issue.

Nor is it indisputable that Professor Huxley has assigned their proper value to pain and suffering in the world of life. Even if it were true that the consummation of pain is reached only "in man, the member of an organised polity," this were no isolated fact of far-reaching ethical import; but a fact in dependence on the increased intelligence of civilised man, an intelligence equally susceptible of increased pleasure as of increased pain. For suffering in the animal world, let Wallace and Darwin answer: "On the whole, then, we conclude that the popular idea of the struggle for existence entailing misery and pain on the animal world is the very reverse of the truth. What it really brings about is the maximum of life and of the enjoyment of life with the minimum of suffering and pain. Given the necessity of death and reproduction—and without these there could have been no progressive development of the organic world —and it is difficult even to imagine a system by which a greater balance of happiness could have been secured. And this view was evidently that of Darwin himself, who thus concludes his chapter on the struggle for existence: 'When we reflect on this struggle, we may console ourselves with the full belief that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply.'"[2]

It is not, then, inevitable to regard the cosmic process as evil. Even when man, in various ages, had elaborated the conception of abstract goodness, and had endeavoured to make his justice a doling out of reward and punishment according to merit, it was not necessary to bring in a verdict of guilty against the cosmos. It is quite true that man has seen in all ages the sun shine on the just and the unjust. But it is an easy reflection that the world could not turn round on individual merit, and that if few are so guilty as to deserve the agonies of grief that may come to all, still fewer deserve some of the simpler and most common joys of life. Behind the "self-hypnotised catalepsy" of the devotee of Brahma, behind the aspirations towards Nirvana, behind the "apatheia" of the Stoics, there was a recognition of this worthlessness of the individual:

[2] Wallace's "Darwinism," p. 39.

an equable acceptation of oneself as part of a process: a triumph of intelligence over selfishness.

When we come to Professor Huxley's account of modern thought with its "tendency to move along the old lines to the same results" —that is, to the results of Indian and Greek philosophy—an extraordinary omission becomes obvious. Modern thought pays at least as strong a regard as did Indian or Greek thought to the position of the individual, and the inequality of individual lots strikes at least as harshly as ever against abstract conceptions of justice. But there is a new factor, the consolations of the ideals of conduct expressed in the New Testament. These bring happiness within the reach of the most unhappy, and have altered in the most fundamental way the principles of ethics. If they come with the authenticity assigned them by dogmatists, there is an end of the matter. If they are the climax of an inner spiritual law, which man himself is constantly shaping and perfecting for his own guidance, there is also an end of the matter. For then they would form as integral a part of the general cosmic process as any of the ape and tiger methods, and it would be as absurd to speak of the battle between ethical man and the immoral cosmos as is the well-worn argument of those defending miracles, that a law of nature (gravity) is interfered with when a man lifts his hand.

I can sum up my criticisms of this address very shortly:—

Evolution does not move in cycles, but in a chain.

Man's capacity for pain is a fact in dependence on other facts.

The "immorality" of the cosmic process is at least a matter of doubt.

If the events on this world are part of the plan of a divine creator, speculation on the immorality of the little we understand is futile.

On the other supposition the highest modern ideals and the brightest results to be hoped for in the future are a direct outcome of the chain of evolution, and it is rhetoric with no philosophic basis to write of the struggle between ethical and cosmic nature.

Our consciousness of the process of ethical amelioration, just as the part our consciousness plays in it, is a part of the cosmic process.

P. C. M.

SOME NEW BOOKS.

THE PURSUIT OF HAPPINESS: A Book of Studies and Strowings. By Daniel G. Brinton, A.M., M.D., D.Sc. 8vo. Pp. 280. Philadelphia: David McKay, 1893.

IN his new book Professor Brinton, philologist, ethnologist, and Americanist—gifted with "the pen of a ready writer"—discourses as a physiologist, moralist, and philosopher. He takes for his subject the pursuit of happiness—to the Pessimist a chimera, to the Puritan a crime. Happiness he defines as not pleasure but built on it; its pursuit as the incessant prompting to a higher form of existence. Biologists have discovered, he states, that the avoidance of painful and the search for pleasurable sensations are the first principles of organic animal life, and those which have developed the amœba into the man, in whom it has blossomed into that self-consciousness to which he owes all the growth of his higher nature, his essentially human powers. "The yearning for joy is a cry of Nature." "It is the secret of evolution." Happiness is the reward of effort, but the truth of the Spencerian concept that "the greatest efficiency is the greatest happiness" is denied on the ground that it is historically false, for men most famous by their enormous personal capacity have certainly not been the happiest of their kind. Nor is childhood the happiest age, nor old age the wisest; there is a rabbinical saying, "He who teacheth the old is like one who writeth on blotted paper."

The fact that women are less happy than men is attributed first to inherent physiological differences and their consequences; secondly, to the errors of a false system of education. The author then proceeds to discuss the effects that our bodily and mental constitution, the laws of heredity, environment, and climatic influences produce on our happiness in general. Dr. Brinton does not, like Ibsen, make heredity accountable for everything, but shows how its sinister conditions can be ameliorated, if not actually annulled. He attributes his individual incapacity for the appreciation of music to the fact that musical instruments were excluded from the houses of his Quaker ancestors for five generations. The author then considers how far our happiness depends on ourselves and how much on others; reviews the pleasures of the senses, the emotions, the intellect; advocates the cultivation of Individuality as opposed to Egotism, the promotion of social happiness, and, in conclusion, recapitulates the consolations of the afflicted. In fact, Dr. Brinton's *Studies* might teach us all "how to be healthy and wealthy and wise." The *Strowings* consist of interspersed "Whitmanese" in the form of aphorisms more or less original and quaintly expressed, such as "Distrust the current estimates of great men. They alone are not tried by their peers." "Self distrust is nowhere more appropriate than in discussing difficult questions, and nowhere less displayed."

Dr. Brinton's latest contributions to physiology, phychology, and

ethics, give evidence of thoughtfulness, wide reading, and that intimate acquaintance with human nature characteristic of the wise physician. He has produced a philosophical, up-to-date manual of the "Pursuit of Happiness," which, according to the American Declaration of Independence, is one of the inalienable rights of man. If there is no infallible guide-book to happiness, we may at least learn from this one how to avoid that morbid physiological condition which has been termed the disease of the century—*Ennui*.

In Dr. Brinton's opinion, "Our happiest moments are those in which we believe we can realise our ideals," but it has been well-said by his fellow-countryman, Lowell, "Woe to that man, or that nation, to whom mediocrity has become an ideal."

AGNES CRANE.

THE EVOLUTION OF DECORATIVE ART. By Henry Balfour, M.A., F.Z.S., Curator of the Ethnographical Department (Pitt Rivers Collection), University Museum, Oxford. London: Percival & Co., 1893. Price 4s. 6d.

IT is appropriate that this interesting little volume should come from the Pitt Rivers Curator, for, until General Pitt Rivers designedly studied the art of modern primitive races of mankind, any connected theory of the beginnings of design and decoration was an impossibility. Mr. Balfour has kept closely to General Pitt Rivers' original idea—that of studying the decorative art of the most primitive people now in existence, believing that the methods employed by man in all ages in reaching at conventional design from simple imitation of natural objects have been very much the same. Mr. Balfour's close study of the Pitt Rivers collection since it came to Oxford has enabled him to get much more definite and exact evidence of this process. Shortly speaking, there are two leading methods in the process. Everyone who was not born since the age of typewriters has dropped a blot of ink on his paper, and has found himself elaborating the stain into some fantastic form. So primitive man, finding a knot in the blade of his paddle, has stained and shaped it into a pattern, and has reproduced the pattern more or less rudely along the face of the blade; or, having trimmed the bamboo shaft of his spear, his eye has been caught by the regular pattern formed where the leaves are cut off at the nodes, and he has coloured the markings and the fringe-like scratches made where they cut off the blades. The transition from this to pure ornament comes when the decorative knots or node markings are reproduced upon a blade or stick where their natural origin does not exist. The second method is also familiar. We have all heard of the game called "Russian Scandal," where a simple statement or story, whispered through a chain of persons, appears in utterly unrecognisable shape when the version of the last person is compared with the original. The author has given two most interesting and amusing illustrations in which this little game was played by successive persons, each copying his predecessor's version of an original sketch. So among savage people, some unclad Raphael imitates the human figure on a weapon or a gourd, and future weapon-makers copy his representation of the natural object, until, from a possibly successful picture, a pattern apparently purely geometrical is produced. We have chosen two typical illustrations of the way in which the author deals with his materials, but the book is so short and so readable that it would be unfair, by prolonging this account, to give any reader the slightest excuse for refraining from the book itself.

ZOOLOGY OF THE INVERTEBRATA. A Text-book for Students. By Arthur E. Shipley, M.A. Pp. 458, with many illustrations. London: Adam & Charles Black, 1893. Price 18s. net.

ALTHOUGH zoological text-books are strewn thickly as the leaves in Vallambrosa, it cannot be said that there is no room for Mr. Shipley's work. The smaller text-books are elementary and insufficient; the lapse of time and a quickly advancing science have left behind the once invaluable Claus. Others, English and foreign, are too much affected by the lamentable doctrine of selected types—a method that, however it be a necessary concession to the conditions of time and space in laboratory teaching, is pernicious in a text-book. Mr. Shipley makes a wise parade of the multiplicity of Nature. He does not send the zoological world spinning round on the earth-worm because there is great store of it in the back garden, nor regard the cray-fish as a prop of creation because it can be ordered from the fishmonger.

At the same time, in each larger group a fuller account is given of some important example in order that the most interesting modifications presented by other members may be set forth. Thus, to take an example, in the chapter on Nemertea, *Tetrastemma flavida* is most fully described, but in every point its characters are compared with the diverging characters of other members, and the diagrams and illustrations given are of general application, not special representations of the anatomy of the particular species. Or, again, in the section on Ascidians, the features of *Ciona intestinalis* are made the text, but particular description is avoided by constant reference to other Ascidians.

It may be said that a clear and definite idea of the groups is given, and that a student who reads this book along with the recognised courses of higher laboratory work will have a very good knowledge of the Invertebrata.

Following a time-worn custom, the author places at the beginning of each chapter a few lines in italics entitled "characteristics." These are given in the disjointed, unfinished phrases that invariable custom supposes tenable by the memory. Possibly they are necessary, but they seem a compromise between intelligence and the examination system. Mr. Shipley, it is true, calls them "characteristics," but they will be taken as definitions. A definition of a group of animals would not exist if the personal equation were allowed for, and it is more important that the mind of the student should be fixed on the connections than on the distinctions between the groups. His concept of the group must always be his knowledge of the animals in it. Curiously enough, the author, while giving "characteristics" for the Protozoa, Metazoa, and the groups like the Coelenterata, Porifera, and so forth, has not attempted them for the Coelomata and Acoelomata, but has remained content with the much more scientific method of writing a little chapter or section on them.

In classification, Mr. Shipley is convincing and ingenious.

The book is well illustrated, well indexed, and conveniently arranged.

THE LEPIDOPTERA OF THE BRITISH ISLANDS, By Charles G. Barrett, F.E.S. Vol. I., Rhopalocera. Pp. viii., 313, pls. xl. London: L. Reeve & Co., 1893 Price £1. 10s. (with coloured plates, £2. 10s.).

THIS volume on British Butterflies is the first of a work on our native Lepidoptera, uniform with Fowler's "Coleoptera" and Saunders'

"Hemiptera." No work on the most popular of insect-orders, on such a scale as the present, has appeared for many years. The great increase of collectors and observers, while it has added vastly to the facts available for such a book, renders the author's task of sifting and arranging his material more onerous than in former times.

The introduction on the Lepidoptera generally occupies only ten pages, and anatomical statements are made very loosely. We are told that "insects of this order are never provided with jaws," that "they take food . . . by means of a flexible proboscis or trunk which is really a long, hollow, double tongue," and that they are "also provided with a pair of palpi attached to the labium or lower lip." Not a word informs the student that the "tongue" and the labium are each formed by the union of parts of a pair of jaws.

The old arrangement of the families is followed in the main, the Papilionidæ coming first and the Hesperidæ last. It seems a pity that the issue of this work was not used to familiarise British lepidopterists with Bates' order, now generally accepted, in which the Danaidæ stand at the head of the series, and the Papilionidæ are relegated to the place required by their affinities, just before the Hesperidæ.

In the systematic and faunistic portion of the work, however, which is in such publications the principal consideration, Mr. Barrett's long practical experience ensures a valuable result. After a good and original description of each butterfly, and its larva and pupa when known, we are furnished with notes on the variation shown by the insect, its localities, and habits. The attention paid to varieties is the feature of the work, and many remarkable local or aberrant forms are figured in the plates. But there is comparatively little suggestion on the vexed question of the causes of variation. Possibly this may be furnished in later volumes.

Naturalists will read with considerable interest the excellent notes on habits and localities given with each species, and will note with regret how many of our finest butterflies are on the road to extinction, if not extinct already. The generation of entomologists who saw *Chrysophanus dispar* alive is now passing away, and it seems that the present generation will see the last of *Aporia crataegi*, *Lycæna arion*, and *L. acis* as British insects. On the other hand, we have several additions recorded. *Danais archippus*, *Lycæna bætica*, *L. argiades*, and *Hesperia lineola* are now considered as entitled to a place in our fauna, though, owing to the absence of the food-plant of its larva, the first-named butterfly can never be more than a casual visitor to our shores.

The figures of the butterflies are generally good, but the caterpillars are often drawn in an attitude very suggestive of "blown" specimens.

THE HAWKS AND OWLS OF THE UNITED STATES IN THEIR RELATION TO AGRICULTURE. By A. K. Fisher, M.D., U.S. Department of Agriculture, Division of Ornithology and Mammalogy; Bulletin No. 3. Pp. 210, pls. 26. Washington, 1893.

ILLUSTRATED by well-executed coloured plates of twenty-six of the species described, this excellent little monograph of the diurnal and nocturnal birds of prey inhabiting the United States should prove valuable alike to the field naturalist, the agriculturist, and the game-

preserver. It may be hoped, indeed, that its issue will do something to check the lamentable slaughter of these birds, which, if not stayed in time, appears only too likely to reduce many parts of the United States to the same condition as the British Islands in regard to birds of prey.

In the introductory chapter, the author enters into general considerations regarding the feeding-habits of hawks and owls, and comes to the conclusion that while a few of the former group are harmful to the poultry-keeper and game-preserver, in the greater number of cases the benefits conferred by the members of both groups far outweigh their depredations. A few species, moreover, like the swallow-tailed kite and the Mississippi kite, are absolutely beneficial, feeding entirely on reptiles and other noxious creatures. While the owls are chiefly instrumental in keeping in check the various species of rodents which are so harmful to the agriculturist, the smaller Accipitrines do equally good service in ridding the fields of the swarms of grasshoppers and kindred insects by which they are too often devastated. With this unmistakable verdict in their favour, we trust that we may ere long hear the last of the offer of bounties for the wholesale destruction of these interesting birds.

The total number of species of birds of prey recognised in this volume as inhabiting the United States is upwards of fifty, among which seventeen are owls, while the remainder, inclusive of the osprey, are Accipitrines. Many of these, it need scarcely be observed, are solely American, while others, like the duck-hawk, are merely varieties of Old World species, and others again, such as the golden eagle, differ in no respect from their representatives on this side of the Atlantic. The chief diagnostic features of each species are briefly but clearly given; while especial attention is directed to the areas of distribution. The especial feature of the book is, however, the care which has been bestowed in ascertaining the precise nature of the food of each species; for which purpose elaborate tables are given, describing the contents of the stomach of a large series of specimens, reaching in some cases to over a couple of hundred. Such researches must have entailed enormous labour on the part of the author and his assistants, who, with the Department, deserve the thanks of all ornithologists.

R. L.

HANDBOOK OF BRITISH GUIANA. By James Rodway. 8vo. Pp. 93. Georgetown British Guiana, 1893.

MR. RODWAY is well known to the readers of NATURAL SCIENCE; in a series of articles full of life and interest he has made us familiar with the forests of British Guiana, and now he gives us a general description of the country, its inhabitants, climate, geology, fauna flora, industries, its past history, and its resources and capabilities for future progress. Besides a map and a chart showing the steamer routes, there are five-and-twenty excellent plates reproduced from photographs, bringing vividly before us, now the splendid falls of the Masaruni or the Kaieteur, now the solitary grandeur of Roraima, towering upwards like a gigantic castle from a slope six thousand feet above sea-level, an immense sandstone rock, with an area of 32 square miles; or we are looking down on the walls and roofs of Georgetown, or New Amsterdam, standing out sharp and clear in a setting of tropical vegetation, or it is the vegetation itself which forms the

subject of the picture, the dense tangle of the forest, a clump of palms, or the *Victoria regia*, with its broad tray-like leaves quite hiding the surface of the water.

Along the coast is a fringe of alluvium so fertile that alternation of crops is unknown, sugar-canes growing year after year in the same soil with hardly any deterioration. Plantains, Indian corn, yams, sweet potatoes, and a host of fruits ripen all the year round; at present hardly a tenth of this is under cultivation. Behind lie swamps choked with tall sedges, with here and there an island of sand on which a few trees and bushes manage to exist, or wherever the land begins to rise, grand clumps of the magnificent Eta palm (*Mauritia flexuosa*). Then come the sand-reefs, the white beach of ages long ago. Miles and miles of pure sand, washed clean as driven snow, dazzle the eyes in the glare of the noonday sun. Behind the reefs the flatness of the coast gives place to an undulating country, gradually rising to hills, and then mountains, and clothed for its greater portion with primeval forest—part of the wilderness of teeming vegetation which covers most of tropical South America. This wilderness abounds with riches. There is gold in the river beds, the working of which increases every year; but of incalculably greater value is the timber in the forest. For piles, wharves, and other structures more or less immersed in water, greenheart timber, says the writer, is perhaps the very best in the world. It is also classed with teak and oak by "Lloyd's" as the most suitable for ship-building. Mora is another first-rate timber for house-frames and ship-building, and although not so lasting as greenheart, "better even than oak for all purposes to which that excellent wood is applied." Wallaba is a very useful wood, as it is easily split into shingles and paling staves, and is far more durable than oak for the large vats necessary for water storage. Among the hundreds of varieties of woods found in the colony are some of the hardest and heaviest in the world, as well as others that are light. They vary, too, in colour from nearly black through the various shades of brown to almost pure white. Where the forests are broken are the savannahs, a paradise to the botanists, especially in the mountain region. Among foaming rivulets, running through banks of ferns and mosses, grow some of the most beautiful flowering plants—orchids, utricularias, droseras, and a hundred others—in the wildest profusion.

"The climate of the colony is on the whole a very pleasant one." The variations of the thermometer are but slight, generally from 76°—86° F., while on the coast the sea breeze tempers the greatest heat, and the heavy rains cool the earth and cause so luxuriant a vegetation that an arid tropical appearance is hardly ever present. Sometimes, however, a protracted dry season brings a drought. Destructive earthquakes and hurricanes are not experienced, while accidents from lightning are said to be almost unknown. Besides large areas on the coast, thousands of square miles of fertile river bottoms and valleys in the interior await cultivation. The great difficulty is the ever-present labour question. The emancipation of the slaves caused the ruin of many estate owners, and led to the plantations being abandoned, the negroes refusing to work at all except for wages which, with the low price of sugar, the staple product, no one could afford. Labour is now obtained by immigration from East India and China, but the

great want of the colony is settlers, energetic and industrious, with some capital, and prepared to rough it a little at first.

For further information on the colony, its beauties and resources, we must refer the reader to Mr. Rodway's very readable little handbook.

MODERN METEOROLOGY. By Frank Waldo, Ph.D. [Contemporary Science Series.] London: Walter Scott, 1893.

ON taking up this book, which is one of the Contemporary Science Series, the attention is at once fixed upon the title. Why should the author have chosen the exact title of a well-known existing work? This feeling of surprise is intensified by further acquaintance with the contents of the book. It is not an account of the present state of the Science of Meteorology. It neither completely supplements nor replaces Scott's and Abercromby's work, neither is it a picturesque and popular version. What is it then? It is a series of fragmentary essays dealing with certain branches of Meteorology. There is much detail given concerning the internal arrangements and routine of observatories, and there is a long account of the theories of Von Bezold, Hann, and Ferrel upon the circulation of the atmosphere. Indeed, the value of the book lies chiefly in this latter portion, which will be very useful to those English and American meteorologists who cannot read the works of the German authors themselves. Whole sections of the science are either omitted or referred to in a most sketchy manner. From the preface it is clear that Dr. Waldo is fully aware of the true character of his work, inasmuch as he remarks: "As I have been mainly a student of what may be termed the German School of Meteorology, I probably have not brought into sufficient notice the names and work of French, English, and Italian meteorologists." In other words, such advances as have been made by English, Scottish, French, and Italian meteorologists are scarcely referred to in a work called "Modern Meteorology"! Let the author change the title to "Some Chapters in Meteorology," or "Meteorological Essays," or some similar description of his work, and there will be less reason to quarrel with him; though, even then, it will be a matter of astonishment that anyone can reprint the absurd picture on page 193. In many ways the work is good and useful, but the general result is disappointing.

OBITUARY.

KARL SEMPER.

Born July 6, 1832. Died May 29, 1893.

WE regret to have to record the death of the eminent Professor of Zoology in the University of Würzburg. Born at Altona, near Hamburg, sixty-one years ago, Karl Semper was the son of a distinguished architect of that city. At an early age he entered the University of Würzburg, devoting himself especially to the study of Zoology. During the years 1859-61 he made a scientific exploration of the Philippines, and in the following year pursued zoological researches in the Pelew Islands. In 1864 he proceeded again to Mindanao, in the Philippine Islands, and in 1866 returned to Würzburg as Privat-docent in the University. Two years later Semper became extraordinary Professor of Zoology in the same University, and in 1869 he succeeded to the ordinary chair. A new Zoological-Zootomical Institute was subsequently erected, and of this the Professor became director in 1872. His most important work is the series of five volumes detailing the scientific results of his travels in the Philippine Islands, published in instalments between 1867 and 1886, partly in co-operation with other zoologists in special departments. In 1877 the Professor was invited to deliver a course of lectures at the Lowell Institute, Boston, and on this was based the work by which he is best known to readers in this country, "The Natural Conditions of Existence as they affect Animal Life." Apart from his own researches, Professor Semper made great contributions to the progress of Zoology by directing the work of his pupils into profitable channels; and the series of volumes of "Arbeiten," published by the Zool.-zootomical Institute of Würzburg, is filled with scientific results of great value.

THE death is also announced of Carl Friedrich Nyman, of Stockholm, author of the well-known *Conspectus Floræ Europeæ*; of Henry Eliason Seaton, the young and promising Assistant Curator of the Gray Herbarium, Harvard University; and of William Reid, of Nairn, a keen observer in ornithology and ichthyology, to whom many authors own much indebtedness.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

PROFESSOR BALDWIN SPENCER, of Melbourne, is spending his vacation this year in Europe, leave of absence having been extended until December.

DR. W. DEECKE, the well-known palæontologist of Greifswald, has been appointed extraordinary Professor of Palæontology in the University of that city.

MR. H. YULE OLDHAM, Lecturer in Geography in the Owens College, Manchester, succeeds Mr. J. Y. Buchanan as Lecturer at Cambridge.

MR. E. B. POULTON, F.R.S., has been appointed Hope Professor and Curator of Entomology in the University of Oxford, in succession to the late Professor Westwood.

MR. W. FISHER, late of the Department of Forestry in India, has been appointed Assistant Professor of Forestry in the Royal College, Cooper's Hill.

THE honour of knighthood has been conferred upon Dr. B. W. Richardson, F.R.S. The University of Durham has conferred the Honorary Degree of D.C.L. upon Sir Henry H. Howorth, F.R.S.

THE University of Pennsylvania conferred, on May 10, the honorary degree of "Doctor of Science" on Daniel Garrison Brinton, M.D., LL.D., of Philadelphia, Professor of Ethnology in the Academy of Natural Sciences of that city and of American Archæology in the University of Pennsylvania, in recognition of his numerous contributions to linguistics, ethnology and American archæology.

THE University of Dorpat, now Jurjeff, is beginning to issue its publications, according to the Imperial decree, in the Russian language. We have just received what appears to be an important thesis on the development of the carpus and tarsus in mammals, illustrated by three beautiful plates; but the work is not accompanied even by an abstract in French or German, and it will thus be of little service to the majority of anatomists interested in the subject.

ACCORDING to *Indian Engineering*, a Committee for the establishment of a Pasteur Institute in the Punjab Himalaya has held its first meeting at Lahore, when a working scheme was decided upon, and it was determined, in the first instance, to ascertain from the Government of India the conditions under which a Pasteur Institute, supported by the public, could be amalgamated with the Imperial Bacteriological Laboratory which is to be transferred from Poona to the Punjab Himalaya.

THE Rothschild Museum, Tring, has just received from Madagascar some limb-bones of the extinct struthious bird, *Æpyornis*. In size they exceed the largest known bones of *Dinornis* from New Zealand. They seem to indicate that the tibia of the Madagascar bird was relatively shorter than that in the New Zealand genera.

WE regret to learn that the fund collected by the Owen Memorial Committee is still insufficient to carry out adequately the resolutions adopted at the meeting of subscribers held early in the year. It is to be hoped that the proposal to place a marble statue of the late Sir Richard Owen in the great hall of the Natural History Museum at South Kensington will not lapse from want of pecuniary means; and we would urge all who have not yet subscribed but who desire to honour the memory of the deceased Naturalist, to forward their donations without delay to Sir William Flower, Treasurer of the Committee.

ACCORDING to a recently-issued circular, the total amount of the contributions received is only £935, and in the list of subscribers many well-known names are conspicuous by their absence. We are surprised to notice how small a proportion of Sir Richard Owen's former colleagues in the British Museum and other scientific departments of the Government have responded to the appeal. The name even of the present Hunterian Professor at the Royal College of Surgeons does not appear in the list.

MR. R. W. ATKINSON, for six years Honorary Secretary of the Cardiff Naturalists' Society, has resigned office, and Mr. Walter Cook succeeds him.

AT the anniversary meeting of the Linnean Society on May 24, the gold medal was conferred on Professor Daniel Oliver, F.R.S. On presenting the medal, the President, Professor Stewart, referred to the wide character of Professor Oliver's work, including besides his extensive contributions to systematic and geographical botany, papers on the morphology and anatomy of plants. The "Lessons in Botany" was mentioned as the most useful elementary book we have, and the President also referred to the thirty years' tenure of the chair of botany at University College.

FROM the Annual Report of the Essex Field Club for 1892 (*Essex Naturalist*, April–May, 1893), we learn the final arrangements for the amalgamation of the Essex and Chelmsford Museum with the Essex Field Club. The collections of the two societies are now in process of arrangement in the old Museum at Chelmsford pending the erection of new buildings. The subscribers to the old Essex and Chelmsford Museum have been admitted as Members of the Essex Field Club, which now increases its ranks by nearly a hundred persons. The headquarters of the Club will shortly be removed to Chelmsford.

AT the Annual Meeting of the Haslemere Natural History Society, held on May 29, Mr. Jonathan Hutchinson, F.R.S., was elected President for the ensuing year. The Society proposes in future to publish "Records of Lectures and Addresses" delivered at its meetings. A Museum is also in course of formation, but the Society cannot hope for much success in this direction until it is able to decline the offers of those well-meaning but mistaken donors, who are likely to convert it into a "curiosity shop."

DR. R. BLANCHARD, Secretary of the International Zoological Congress, announces that the subject for the first award of the prize offered by Czarewitch of Russia is "A Study of the Fauna of one of the great Regions of the Globe and its Relations to the neighbouring Faunas." Manuscripts must be received before May 1, 1895, and they may relate either to a Fauna in general or to one particular class of animals. The award will be made at the Leyden Meeting in 1895, on the report of a Committee consisting of Messrs. Milne Edwards, Blanchard, Bogdanov, Zograf, Jentink, Studer, and Bowdler Sharpe. Detailed particulars may be obtained from the office of the Congress, 7 Rue des Grands-Augustins, Paris.

THE following letters have been circulated this month among the Fellows of the Royal Geographical Society of London:—

"Savile Row, W.
"1st June, 1893.

"Dear Sir,—At the recent Anniversary Meeting of the Royal Geographical Society, in the course of a discussion on the admission of ladies to its Fellowship it was suggested, and the suggestion met with the approval of the meeting and was accepted by the President, that the best course would be to obtain the opinion of the body of the Fellows throughout the country. General R. Strachey—acting in the absence of Mr. Clements Markham—has consequently directed me to send you the accompanying note and postcard. A general vote, thus taken, is not formally binding on the Society, but its result will, there is every reason to believe, be acquiesced in and confirmed by a General Meeting, as a conclusion to the recent controversy.

"The admission of ladies to the Society is no new idea. It was accepted in principle as a measure both of justice and expediency by the Council in 1887. Its application was deferred to a convenient occasion, and that occasion arose when last year an eminent lady traveller, Mrs. Bishop (Miss Bird), declined to furnish a paper to a Society that would not acknowledge her as a geographer. I need not catalogue the many other ladies, from our Gold Medallists, the late Mrs. Somerville and Lady Franklin to Miss Edwards and Miss North, whose names are well-known to all interested in the literature and results of travel.

"The ladies the Council particularly desire to see admitted as Fellows are, in the first place, travellers who contribute to geographical knowledge, and also ladies who have so warm an interest in geographical progress that they desire regularly to attend our meetings and to use our library. Up to the present time, such ladies, if widows or unmarried, have only been able to be present at meetings by begging a ticket on each occasion from a Fellow. The Society has refused their subscriptions, and they have been debarred from the privileges accorded to members. Is not such a state of things an anomaly at a date when ladies are already admitted as members of a large proportion of the more important Scientific Societies of the metropolis, and of, I believe, all the other Geographical Societies in the United Kingdom and the Colonies? It appears in this light, not only to the Council, but also to Fellows of such experience as Lord Northbrook, Lord Brassey, Sir John Lubbock, Sir Alfred Lyall, Sir Richard Temple, and Sir William Flower, P.Z.S., and Director of the Natural History Museum, not to mention many others. In my own twelve years' experience as one of the Honorary Secretaries of our Society, I may venture to subscribe to their opinion and to express my belief that the admission of qualified ladies as Fellows will add to the prosperity and reputation of the Society, and greatly conduce to its main object—the growth of geographical science—and to geographical knowledge.

"Some of our Fellows have recently found a legitimate subject of complaint in the fact that, owing to the extensive use by Fellows of their privilege of admitting a companion, the best seats at the most interesting lectures have sometimes been half filled by ladies. It must be pointed out that the Council have recently taken a step that will remedy this grievance by modifying a bye-law, so as to empower the officers, on occasions of exceptional interest, to seat all Fellows before any guests. It would obviously be unjust to exclude qualified ladies from the Fellowship because unqualified ladies, admitted as visitors, have occasionally occupied an unfair proportion of our benches!

"The Council, deeply impressed by the importance of geographical knowledge to the generation of the English people, and noticing every day how its absence is felt in questions of politics, of commerce, or of emigration, trust you will be able to agree with their view, and to answer the question submitted to you in the affirmative. "I am, yours faithfully,

"DOUGLAS W. FRESHFIELD, Hon. Sec."

"Royal Geographical Society,
"1 Savile Row,
"Burlington Gardens, W.,
"5th June, 1893.

"Sir,—I am desired by the Council of the Royal Geographical Society to inform you that Mr. Freshfield's letter of June 1st was written and issued without their authority or knowledge, and that his action in so writing has been disavowed by them. The Council as a body have no wish to influence the judgment of any Fellow in the matter.

"I have the honour to be,
"Your obedient servant,
"R. STRACHEY, Vice-President."

We need not add to our remarks last month. So far as we can judge, all the Royal Geographical Society's difficulties have arisen from the usurpation by the Council of powers exclusively belonging to the Fellows assembled in a Special General Meeting; and the time for granting the Fellowship to ladies has thus been unfortunately postponed.

DURING the absence of Mr. Theodore Hughes in England, Mr. T. D. La Touche undertakes the duties of Superintendent of the Geological Survey of India. We briefly referred last month to the new orders under which the work of the Survey will for the future be directed more especially to subjects of economic interest, and we are now able to add some further particulars. It is ordered that two-thirds of the officers shall always be primarily engaged on the explorations necessary to complete the geological survey, and the remaining third on the practical investigation of mineral fields. In the latter case, the exploration will be confined to such preliminary researches as may be necessary to supply general information regarding their character and extent to capitalists and promoters, to whom will be left the responsibility for more detailed prospecting. According to the recently-issued annual report, the most important scientific work of the past year was that carried out in the Central Himalaya by two of the survey officers in co-operation with Dr. Diener, the eminent geologist of Vienna, and their joint researches are said to be certain to prove of high scientific interest. There were experimental borings for oil in Beloochistan and on the Indus, investigations into the Nerbudda coal-fields, the coal resources of Tenasserim, jade in Burmah, coal and rubies in the regions bordering on Yunnan, and much else of a similar character. The advance in the knowledge of Indian coal-fields has been great. The centres of production, which a few years ago were almost confined to Bengal, have now been extended to Assam, Punjab, Central Provinces, the Nizam's territory, and Burma. The survey has also done much to determine the character of the oil resources of the country, and soon the question will be set at rest whether any important or permanent supply of oil can be secured in Northern India.

CORRESPONDENCE.

The Recrudescence of Leprosy and its Causation.

As the readers of Natural Science would scarcely comprehend the full scope and purport of my recently-published volume, "The Recrudescence of Leprosy and its Causation," from the brief notice in the April number, I shall be glad to be allowed space for a summary of my conclusions, the result of personal investigation in many countries where this terrible disease is endemic. I can prefer this request with the more urgency from the fact that many of the sufferers from leprous vaccination are absolutely friendless, while most of them are without political representation and are unable to plead their own cause. In the pursuit of my inquiries I have been repeatedly entreated to bring their intolerable grievances before the English-speaking public through the Press, with a view of reaching the ears of Parliament and other legislative bodies.

These conclusions are as follows:—

(1.) That leprosy has greatly increased during the last half-century, and that it is prevalent in many places where it was formerly unknown.

(2.) That whilst the opinion of medical authorities and experts varies considerably on the subject of the contagiousness of leprosy, the preponderance of authority is in favour of the theory that it is not contagious in the ordinary sense of the term, but is communicable by means of a cut, sore, or abraded surface; and this view is confirmed by my own personal investigations.

(3.) That other alleged factors such as malaria, a fish diet, syphilitic cachexia, heredity, and insanitation are admittedly unequal to explain the rapid growth of the disease in certain of our Crown colonies and dependencies, as well as in other countries.

(4.) That on one point there is much agreement, and hardly any dissent, namely, the inoculability of leprosy; and that the view of leprosy as an inoculable disease, while it is most clear to those who take the malady to be due to a bacillus, is older than the bacteriological evidence, and is not dependent thereon.

(5.) That the most frequent opportunities of inoculating the virus of leprosy are afforded in the practice of vaccine inoculation, which is the only inoculation that is habitual and imposed by law; and that the evidence here adduced is calculated to show that vaccination is a true cause of the diffusion of leprosy.

(6.) That the official information, collected by interrogatories and otherwise, has not been hitherto of a kind to show how far vaccination has determined the amount of leprosy in recent times; and that any interrogatories that may be sent out in future should not be limited to ascertaining the effects, as regards leprosy, of hypothetically "pure lymph." When, on very rare occasions, interrogatories have been submitted, they have been framed to ascertain the results of a purely hypothetical system of vaccination, which is not anywhere discoverable in practice (*i.e.*, with pure lymph, and free from hereditary taint), and the replies are therefore futile and misleading.

(7.) That with the exception of two groups of cases—those adduced by Dr. Roger S. Chew, of Calcutta, and Dr. S. P. Impey, of Robben Island—those reported in this volume have not been the result of special investigations, but have cropped up accidentally in the course of medical practice, and in some instances have been published by practitioners, with apologies to the profession for presenting such unwelcome disclosures.

(8.) That the increase of leprosy in the Sandwich Islands, the West Indies,

the United States of Columbia, British Columbia, British Guiana, South Africa, and New Caledonia has followed *pari passu* with the introduction and extension of vaccination, which in nearly all these places, without previous inquiry or demand from the inhabitants, has been made compulsory.

(9.) That as leprosy is a disease of slow incubation, often taking years to declare itself, and in its incipient stages can be detected only by practitioners of large experience, it follows that, in countries where leprosy exists, there is great danger of extending the disease by arm-to-arm vaccination.

(10.) Leprosy being one of the most loathsome diseases to which the human race is subject, and being practically incurable, it behoves all interested in the public well-being to do their best to *prevent* its diffusion, and as a means thereto, to discourage the practice of vaccination on that ground, if on no other.

Devonshire Club, St. James's, S.W. WILLIAM TEBB.
24th May, 1893.

MR. HICK AND *Calamostachys Binneyana*, SCHIMP.

IN the letter which appears in the last issue of NATURAL SCIENCE (vol. ii., p. 480), Professor Williamson announces that the "true answer" to my article on "The Fruit-Spike of Calamites" (NATURAL SCIENCE, vol. ii., pp. 354–359) will be given in a memoir which he and Dr. Scott hope to present to the Royal Society before the close of the present year. May I, on my part, refer those who are interested in the matter to the forthcoming volume of the *Proceedings of the Yorkshire Geological and Polytechnic Society*? There, a paper will be found in which I have given a full description of the beautifully-preserved specimens on which the article is based, so far as it deals with *Calamostachys Binneyana*, Schimp., as the fruit of some form of *Calamites*.

THOMAS HICK.

TO CORRESPONDENTS.

All communications for the EDITOR *to be addressed to the* EDITORIAL OFFICES, *now removed to* 5 JOHN STREET, BEDFORD ROW, LONDON, W.C.

All communications for the PUBLISHERS *to be addressed to* MACMILLAN & CO., 29 *Bedford Street, Strand, London, W.C.*

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ANSWERS TO CORRESPONDENTS.

HENRY JOHNSON.—Laurence Oken's library was sold by auction on 17 May, 1853, at Zürich. It consisted of 5,881 items, 600 of which were Historical, Classical, and Theological books, the rest dealing with the Natural Sciences.

C. W. K. (Leeds).—You will find that Hagen's *Bibliotheca Entomologica* (Leipzig, 1862) gives the majority of writings on Insects previous to the date of its publication. There is a good index, and you can find out the papers on the special group you want. After Hagen, the volumes of the *Zoological Record* should be consulted.